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Bulletin No. 348- 368 *September, 1940*

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Oats in Mississippi..

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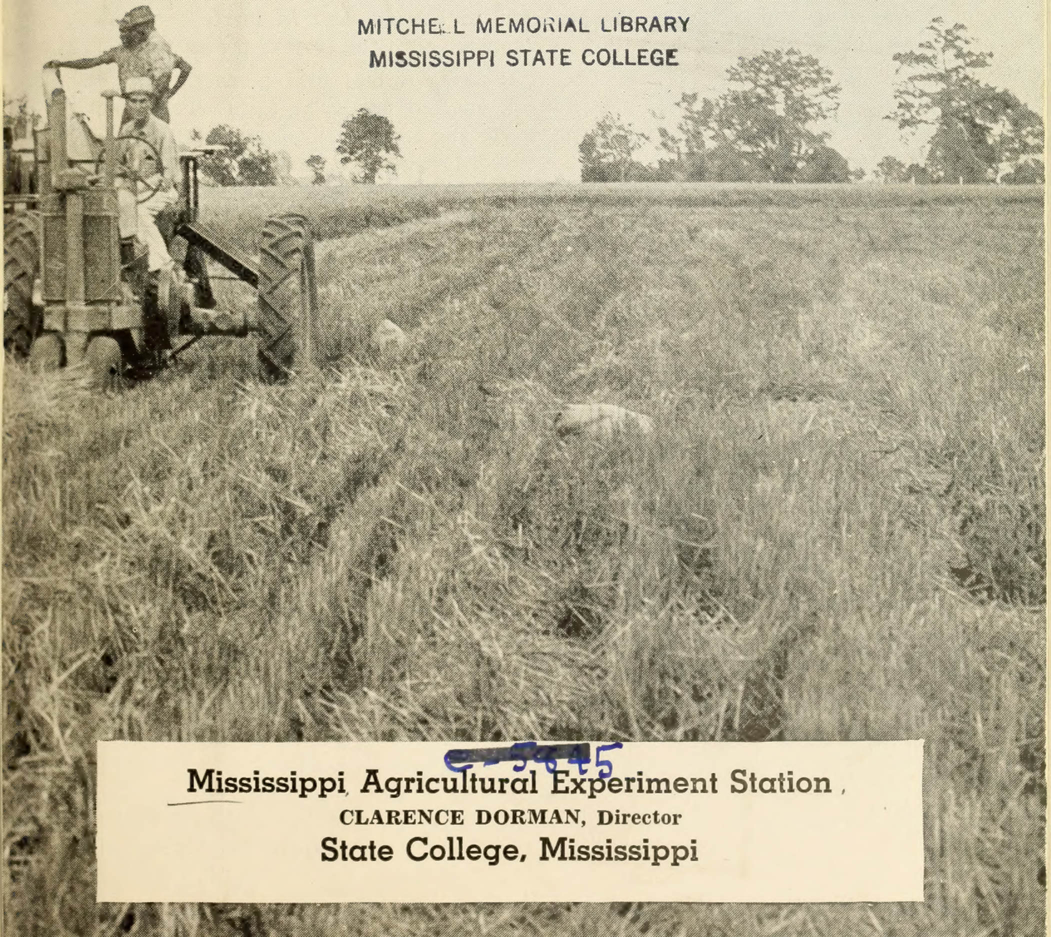

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Mississippi Agricultural Experiment Station
CLARENCE DORMAN, Director
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The production of oats in Mississippi has increased greatly in the past few years. This is largely the result of increased acres planted to oats and improved farm practices which increase yields per acre.

The total annual acreage seeded to oats in Mississippi during the 10-year period 1929-1938, according to Crops and Markets, published monthly by the United States Department of Agriculture, was 45,000 acres. According to the same authority, the acreage seeded to oats in Mississippi in 1939 was 76,000 acres and in 1940, 114,000 acres. Average annual production for the 10-year period 1929-1938 was 1,043,000 bushels. In 1939 the yield was 2,736,000 bushels, while the yield indicated July 1, 1940, was 3,648,000 bushels. The figures indicate an increase of approximately 150 per cent in acreage and in increase of more than 250 per cent in yield in 1940 as compared with the 10-year period 1928-1939.

Oats have been produced on Mississippi farms since pioneer days, but mainly as a source of feed for livestock on that particular farm. This should still be considered an important phase for the small farm owner who does not have sufficient capital to buy the needed equipment for commercial grain production. More recently, however, and especially in the Yazoo-Mississippi Delta area, oats have developed into a cash crop for sale as grain and under controlled farm conditions for sale as seed.

The yield of oats per acre in Mississippi has been too low for profitable production, being only 22.3 bushels per acre during the period 1929-1938. In recent years the yield per acre has increased greatly, being 27.0 bushels in 1938 and 36.0 bushels in 1939.

The increasing importance of oat production in Mississippi agriculture as well as the adaptability of at least certain of our widely distributed soils, is further emphasized in figures showing Mississippi's standing in oat production in relation with other states. According to the July 1940 Crops and Markets during the 10-year period, 1929-1938, Mississippi and Kansas were tied for thirty-first place among the states in average yield of oats per acre. In 1940 Mississippi ranked seventh among the states in average yield of oats per acre

Oats in Mississippi

By ROY KUYKENDALL, JOHN PITNER, J. F O'KELLY,
J. L. ANTHONY and C. DALE HOOVER

Oat studies at the Delta Branch Station were begun in 1921, and have been greatly extended during recent years. The purpose of this work was to determine preferred farm procedure on major factors entering into oat production. The investigations have, therefore, consisted of the following experiments:

1. Variety comparisons
2. Dates of seeding
3. Rates of seeding
4. Fertilizers.

Oat studies in the present series were begun by the Mississippi Experiment Station at State College in 1935 and have been greatly extended during the past two years. These investigation have consisted of the following experiments:

1. Variety comparisons
2. Fertilizers.

Possibly one of the greatest hindrances to profitable oat production at present is the prevalence of infestations of cheat, chess, and other weeds which result in poor quality and low yield. During the harvest period of 1940, inspections were made of numerous plantings of oats in the Delta and hill section of the state for the purpose of seed certification. In numerous instances certification was necessarily withheld because of the considerable contamination with weeds and because of varietal mixtures. To fully utilize the opportunity for profitable oat production in Mississippi, proven practices with respect to varieties, fertilization, and handling must be adopted. The full utilization of this opportunity also involves the necessity, first, of securing weed-free seed oats of the desired variety, and second, of maintaining freedom from weed seeds by constant vigilance, especially at the time of harvesting. It must be remembered that good quality and high yields cannot be obtained from planting "ordinary commercial feed oats." It is impossible to over-estimate the importance of planting pure seed.

Studies conducted by the Delta Branch Experiment Station, by the Mississippi Experiment Station at State College, and by substations at Holly Springs, Raymond, and Natchez, indicate that further progress may be made in profitable oat production. These studies show that under normal climatic conditions, soils of the Delta and the Brown Loam Region produce profitable oat yields. In the Delta high yielding and adapted varieties planted in the fall at the rate of 2 to 3 bushels of seed per acre and fertilized with 30 pounds of commercial nitrogen produce an average of from 60 to 90 bushels of oats per acre. In the Hills, profitable oat yields may be obtained by planting high yielding and adapted varieties at the rate of 2 to 3 bushels per acre and fertilizing with 16 pounds of commercial nitrogen. Since the results from Delta Branch Station are from tests conducted over a longer period of time than those conducted by the Mississippi Experiment Station, State College, in the hill sections, they are discussed and summarized separately.

It is the purpose of the bulletin to summarize the oat work conducted by the Delta Branch Station and the Mississippi Experiment Station and to interpret the results of the experimental work with respect to the fundamental factors of oat production.

OAT EXPERMENTS AT THE DELTA BRANCH STATION

Variety Comparisons

Each year since 1921 the Delta Branch Station has obtained planting seed of several of the leading varieties of oats on the market and some of the more promising new strains. These were planted in variety tests for the purpose of yield comparisons. The tests were not conducted on the same soil every year but most of them were on a loam soil. The oats were seeded in the fall except where comparisons were made of fall seedings and spring seedings. The same varieties were not used every year because of the year-by-year elimination of unsuitable varieties with the result that during recent years most of the older varieties have been replaced by newer strains. Table 1 presents the results of the last six years of this work.

It will be noted that Red Rustproof varieties, such as Nortex, Delta Station Strain, Ferguson, Hastings 100 Bushel Appler, and Bayliss usually produce higher yields than other varieties; and that Fulgrain outyielded other non-red-rust-resistant varieties. The Red Rustproof strains winter killed only one year.

For the purpose of more direct comparison, the yields of identical varieties obtained from different seed sources were combined in such a way as to show the average yields of those varieties for the greatest number of years during which direct comparisons were possible. This information is shown in table 2.

The results of 20 years work in variety testing indicates that the Red Rustproof strains of oats have produced highest yields. Three varieties have been continued throughout this period and during 13 of these years, 1925-26, 1929-39, one of these, Ferguson 922, has yielded annually 60.7 bushels per acre. However data from recent years show that seed of the newer strains have produced higher yields. During the two-year period, 1938-39, average annual yields were as follows: Ferguson 922, 80.3 bushels; Nortex, 84.6

FIGURE 2—EXPERIMENTAL PLATS IN FERTILIZER EXPERIMENTS

bushels; Delta Station Red Rustproof, 81.6 bushels; Bayliss, 80.2 bushels. Closely following in annual yields were Hastings 100 Bushel, Appler and Terruf. The above named varieties are about ten days later maturing than Fulgrain, Fulghum and Kanota. Yield records indicate that at present Fulgrain is the best early oat variety under the conditions of the work of the Delta Branch Station.

The consistent performance of the Red Rustproof strains throughout the 20-year period seems sufficient evidence of their superiority for grain production. It often occurs, however, that oats of a different maturity date are desired in order that the harvesting period may be extended. Of the earlier varieties to be planted for this purpose, Fulgrain or Fulghum is recommended. Many planters seed 70 per cent of their oat acreage to Red Rust Proof strains, and 30 per cent to Fulgrain or Fulghum, in order to begin harvesting ten days earlier than would be possible were only the Red Rustproof strains planted.

Dates of Seeding

In order to determine the best average date for seeding oats to produce maximum yields, comparisons were made of yields from fall plantings, begun on September 15 and continued in fifteen day intervals until November 15 and from spring plant-

TABLE 1—ANNUAL YIELDS OF VARIOUS VARIETIES OF OATS FOR THE PERIOD OF 1934-40

Variety	Seed (a) Source	1934	1935	1936	1937	1938	1939	1940	Average
Hastings' 100 Bushel	3	78.3	45.7	44.7	70.1	86.2	66.2	97.1	69.7
Fulghum	4	......	......	......	57.2	56 7	42.3	92.1	62.1
Appler	5	72.6	48.3	47.2	65.1	84.7	67.7	91.5	68.1
R. R. P.—Commercial	6	......	......	......	......	84.9	67.8	88.2	80.3
Kanota	8	44.2	14.7	30.4	56.3	44.9	38.0	81.7	44.3
Ferguson 922	2	83.9	39.6	47.3	70.3	91 1	69.4	......	66.9
Bayliss	9	69.0	40.0	43.4	71.7	88.3	72.0	83.5	66.8
Nortex	10	81.2	50.6	65.3	69.7	92 8	76.3	78.7	73.5
Coker Fulgrain (strains 1, 2, and 3)	1	......	......	59.0	68.7	55.4	57.2	88.9	65.8
Delta Station R. R. P.	7	......	......	52.0	73.9	93.4	69.8	86.9	75.2
Terruf	11	......	......	......	......	80.8	73.5	85.2	79.8
Fulghum x Victoria	12	......	......	......	......	......	60.2	84.9	72.5

TABLE 2—AVERAGE YIELDS OF VARIOUS VARIETIES OF OATS FOR THE PERIOD OF 1921-37

	Bushels per Acre									
Variety	13 Yrs. 1925-26 1929-39	12 Yrs. 1921-23 1925-26 1933-39	11 Yrs. 1921-23 1925-26 1934-39	8 Yrs. 1929-36	10 Yrs. 1929-32 1934-39	4 Yrs. 1921-23 1925	3 Yrs. 1923 1925-26	6 Yrs. 1934-39	4 Yrs. 1936-39	2 Yrs. 1938-39
Fulghum	47.3	44.5	46.0	40.4	45.1	39.8	50.7	46.4	48.9	49 5
Ferguson 922	60.7	61.4	62.0	53.3	60.3	50.5	53.7	67.0	68.4	80.3
Kanota	39.2	......	......	30.4	35.2	......	......	38.1	42.4	41.5
Hastings' 100 Bu.		60.6	60.6	......	......	50.3	57.7	65.2	66.8	76.2
Appler			60.6	......	......	50.3	50.7	65.2	66.8	76.2
Norton				39.8						
Baylis					56.3	......	......	64.1	68.9	80.2
Texas R. R. P.							45.3	......	......	......
Dwarf Culberson						29.3	......	......	......	......
Navarro							54.0	......	......	......
Nortex								72.7	76.0	84.6
Fulgrain									60 1	56.2
Delta Station R. R. P.									72.3	81.6
Commercial R. R. P.										76.4
Terruf										77.2

ings begun on February 15, and continued until April 1. The variety of oats used in this experiment was Ferguson 922. The results of these tests are shown in table 3.

These results, as shown in the above table, on dates of seeding indicate very definitely that the middle of October is the best time to plant oats to obtain highest yields. Oats planted October 15 produced an average of 63.3 bushels per acre, which was slightly higher than yields secured from oats planted either October 1 or November 1, and consistently higher than yields secured from oats planted September 15 or November 15. Plantings made February 15 yielded only 16.2 bushels per acre and those made March 15 yielded only 9.6 bushels per acre; those planted later resulted in virtual crop failure.

Rates of Seeding

Experimental work on rates of seeding oats was begun at the Delta Branch Station in 1929 and has been continued to date. The procedure followed in seeding rates were replicated 4 to 8 times and all factors other than seeding rates were kept as nearly constant as possible. The designated amount of seed for each planting was weighed, put in separate packages and broadcast by hand. Most of the experiments were conducted on a loam soil. Ferguson 922 was the variety used. Results of these comparisons are shown in table 4.

Maximum yields were produced when oats were seeded at the rate of 2½ bushels per acre. However, the results show only a slight difference in yield when the quality of oats planted varied from 1½ to 3½ bushels per acre. With the Ferguson strain the 2½ bushel seeding yielded 64.1 bushels. It is likely that these differences are not statistically significant and from two to three bushels per acre appears to be the most desirable rate of seeding.

Nitrogen Fertilization

Since oat yields on land of low fertility are so often disappointing, the Delta Branch Station began work with commercial fertilizers with oats in 1928 to determine the most economical source of nitrogen to use, the most economical rate of nitrogen to apply, and the proper time of application for maximum production.

TABLE 3—YIELDS FROM VARIOUS DATES OF SEEDING OATS

					Bushels per Acre					
Seeding Dates	1931	1932	1933	1934	1935	1936	1937	1938	1939	Average
					Ferguson 922					
October 15	71.6	37.4	79.5	56.2	33.8	51.1	72.2	82.8	87.7	63.6
September 15	81.6	40.3	34.2	60.7	26.1	48 1	55.3	66.3	85.0	55.3
October 1	80.9	41.2	59.1	56.1	29.4	44.5	64.4	67.3	85.4	58.7
November 1	76.4	47.4	80.3	60.7	22.5	24.1	64 2	79.5	78.9	59.3
November 15	85.2	41.9	65.0	70.6	8.6	24.1	64.1	57.9	82.1	55.5
February 15	62 1	0.0	4.7	24.7	0.0	23.2	6.9	12.8	11.1	16.2
March 1	67.5	0.0	0.2	21.8	0.0	24.0	2.0	9.1	11.3	15.1
March 15	48.6	0.0	0.6	15.4	0.0	10 6	1.3	0.0	10.2	9.6
April 1	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	2.7	0.3

TABLE 4—YIELDS FROM VARIOUS RATES OF SEEDING FERGUSON 922 OATS

						Bushels per Acre						
No. Bushels per Acre	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	Average
						Ferguson 922						
2½ bushels	72.3	57.5	95.3	48.5	52 6	73.9	39.3	60.8	61.3	72.5	79.3	64.8
1½ bushels	64.4	61.3	90.8	49.3	49.5	76.9	36.3	59.0	61.3	73.1	78 3	63.2
2 bushels	49.3	58.5	92.7	51.1	48.9	74 0	32.6	60.6	62.1	73.6	79.5	62.1
2¼ bushels	72.5	57.7	89.8	49.0	52.4	82.0	40.9	60.2	57.4	71.6	78 3	64.7
2¾ bushels	68.6	53.4	91 4	48.8	48.4	89.4	42.0	58.6	58.3	71.0	78.5	64.4
3 bushels	73.3	56.5	94.8	52.3	48.0	72 5	43.5	55.8	61.6	69.7	76.8	64.1
3½ bushels	68.7	58.2	106.9	49.1	52.1	63.6	37.4	58.2	53.8	73.6	77 9	63.6

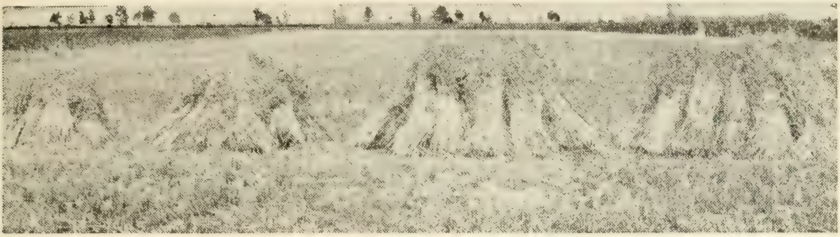

FIGURE 3—Oats in "Rates of Applying Nitrogen" experiment. Left to right: Unfertilized, 94, 188, and 282 pounds of Nitrate of Soda per acre, with 12 year average yields of 21.6, 43,7, 57.7, and 64.0 bushels per acre, respectively.

These tests were conducted on a loam soil and were a part of a three-year rotation consisting of corn, cotton, and oats, all fertilized identical. This rotation has been in progress for 20 years and no legume crop has been grown on this soil during that time. The residue from corn, cotton, and oats is the only organic matter that has been applied during this period.

The Sources of Nitrogen. In order to determine which of the sources of commercial nitrogen would produce highest oat yields, a comparison of results for various sources was begun in 1928. 30 pounds of nitrogen per acre was used from each source, which necessitated that the amount of fertilizer from each source vary in respect to its nitrogen content. Oats were seeded cross-wise in all plats and the fertilizer was weighed separately and applied by hand in the spring. The experiment was conducted on a loam soil. Ferguson 922 and its strains were used every year except 1932 and 1933, when Norton was planted. All factors other than the source of nitrogen were kept as nearly constant as possible. Results are presented in table 5.

During the 13 year period in which sources of nitrogen have been tested, all sources except cottonseed meal more than doubled the yield of the untreated or check plot. 30 pounds of nitrogen from nitrate of soda per acre produced slightly higher yields than a like amount of nitrogen secured from other sources or materials, though the difference was slight when nitrate of soda was compared with ammonium nitrate. The increase in yields due to 30 pounds of nitrogen according to sources was as follows: nitrate of soda, 38.8 bushels; ammonium nitrate, 36.7 bushels; ammonium sulfate, 31.0 bushels; cyanamid, 24.2 bushels; cottonseed meal, 14.1 bushels; cottonseed meal and ½ sodium nitrate, 24.9 bushels.

30 pounds of nitrogen is derived from the following amounts of indicated materials: Nitrate of Soda, 188 pounds, calcium nitrate, 200 pounds, calnitro, 188 pounds; ammonium nitrate, 167 pounds; ammonium sulfate, 146 pounds; granular cyanamid, 143 pounds; pulverized cyanamid, 136 pounds, cottonseed meal, 460 pounds.

Rates of Applying Nitrogen. Since nitrogen is the only major deficient fertilizing element in the west half of the delta, and is probably the most important factor for consideration in respect to increased crop yields, a test was inaugurated in 1928 to determine the most economical rate of applying nitrogen to oats. The rates were varied in 7½ pound increments up to 45 pounds of nitrogen per acre, and nitrate of soda was the source of nitrogen used. The fertilizer was applied in the spring. Ferguson 922 variety and its strains were used every year except 1932 and 1933, when Norton was planted. Yields secured from these rates of applying nitrogen are shown in table 6.

Results of this work indicate that 30 pounds of nitrogen produced the most economical yields of oats, that the greatest response was obtained from less than 20 pounds of nitrogen per acre, and that

TABLE 5—YIELDS OF OATS FROM VARIOUS SOURCES OF NITROGEN USING 30 POUNDS OF NITROGEN PER ACRE

						Bushels per Acre								1928-40
Treatment	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Av.
Unfertilized	40.3	20.8	23.1	49.2	0.6	13.9	11.7	22.7	15.1	27.2	21.1	24.8	21.7	22.5
Nitrate of Soda	70.5	61.7	68.4	102.0	10.4	58.2	53.6	53.3	51.7	65.6	65.6	69.9	65.6	61.3
Ammonium Nitrate	74.8	59.2	60.8	83.2	8.3	51.9	46.2	56.1	54.7	65.6	70.3	72.8	66.2	59.2
Ammonium Sulfate	69.2	56.5	49.9	66.4	6.1	39.8	40.6	50.7	55.4	62.0	65.3	72.8	60.6	53.5
Cyanamid	62.7	52.0	48.9	58.6	11.3	40.0	39.9	45.1	45.8	55.0	47.0	55.6	45.8	46.7
Cotton Seed Meal	58.1	37.0	34.1	67.0	3.5	20.0	21.3	37.0	34.0	45.9	39.0	41.5	37.3	36.6
½ C.S.M. and ½ S. Nitrate	59.5	52.9	39.5	87.7	7.2	34.4	38.4	46.2	44.3	52.1	47.1	55.9	51.0	47.4

TABLE 6—YIELDS FROM RATES OF APPLYING NITROGEN IN 7½ POUND INCREMENTS UP TO 45 POUNDS PER ACRE, USING NITRATE OF SODA AS THE SOURCE

Nitrogen Rates						Bushels per Acre								1928-40
Per Acre	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Average
No Nitrogen	35.5	25.3	22.6	37.2	1.0	16.3	9.2	26.2	14.9	24.6	22.3	26.1	17.7	21.3
7.5 pounds	42.4	32.1	25.6	44.8	4.1	27.1	18.5	37.8	26.1	45.2	39.0	39.3	25.5	31.3
15.0 pounds	52.5	43.5	37.6	57.1	5.6	41.9	31.3	53.1	39.9	60.0	51.7	50.0	37.6	43.2
22.5 pounds	65.1	45.7	46.6	77.2	9.3	44.6	34.2	44.1	48.9	63.2	60.3	60.4	52.4	50.2
30.0 pounds	69.4	50.4	56.2	79.2	7.6	57.9	51.0	54.3	63.0	71.5	61.7	69.8	64.8	58.2
37.5 pounds	78.5	58.4	62.8	77.3	5.0	61.6	57.0	57.4	64.0	74.3	64.8	73.5	66.3	61.6
45.0 pounds	73.4	63.5	66.8	73.6	9.6	70.3	72.2	59.5	68.8	63.3	71.9	75.0	66.5	64.2

very profitable increases were made from applications up to 40 pounds per acre. The application of 7½ pounds of nitrogen increased the yield of the unfertilized plot by nearly 50 per cent, and applications of 15 pounds of nitrogen more than doubled the yield of the unfertilized plot. The use of 30 pounds of nitrogen increased the yield to 56.6 bushels per acre. The second increment, 15 pounds of nitrogen per acre, was the most profitable; and the diminishing returns began with the fifth increment when nitrogen application was at the rate of 37½ pounds of nitrogen per acre. More than one bushel increase in oat yield was obtained for each pound of nitrogen used when the rate of application was 30 pounds per acre.

Dates of Applying Nitrogen. Time and method of fertilizer placement are important considerations wherever crops are fertilized. This is especially true in the case of oats in the Yazoo-Mississippi delta, where the peak of work in cotton production coincides to some extent with the time at which oats are customarily fertilized. An experiment to determine the time at which oats may most profitably be fertilized was begun in 1928 and continued through 1936. Nitrogen was used at the rate of 30 pounds per acre and applied in separate plots at planting on four dates. Results of this work, measured in bushels of oats per acre, are shown in table 7.

Eight years' work indicates March 15 as the best date to apply nitrogen to fall sown oats. It was regarded as significant, although, during these 8 years the results of spring applications of nitrogen barely exceeded results of nitrogen applied at the time oats were planted.

In 1937, the preceding experiment was replaced by a new experiment which was inaugurated for the purpose of comparing spring and fall applications of nitrogen to oats. Three sources of nitrogen were used—nitrate of soda, ammonium sulfate, and cyanamid—and treatments were uniformly at the rate of 30 pounds nitrogen per acre. Fall applications were made in late November, and spring applications were made in early March. Results are shown in table 8.

This experiment has been in progress only four years and the results are not yet conclusive. Results thus far are in accord with results of the 8-year experiment with dates of applying nitrogen, which indicated that nitrate of soda gave slightly better yields when applied March 15. During the 4 years of this experiment,

TABLE 7—YIELDS OF OATS FROM DATES OF APPLYING 30 POUNDS OF NITROGEN PER ACRE USING NITRATE OF SODA AS THE SOURCE

Date of Application	Bushels per Acre 1928	1929	1930	1931	1932	1933	1934	1936	Average
No Nitrogen	30.5	25.3	29.3	45.7	0.7	20.3	9.5	14.3	22.0
November	46.2	60.7	60.0	100.3	3.8	59.5	41.8	53.3	53.2
March 15	57.2	59.7	62.7	101.8	8.2	44.6	51.7	59.2	55.6
April 1	64.6	65.8	62.2	70.4	4.5	40.5	50.7	48.9	51.0
April 15	60.2	64.1	63.8	94.3	2.0	28.2	21.1	47.6	47.7
½ Nov. ½ April 1	53.7	62.6	62.8	90.4	5.6	40.3	48.3	56.8	52.6
½ Nov. ½ April 15	66.8	61.9	59.1	89.3	3.7	29.7	35.6	49.3	49.4

TABLE 8—YIELDS OF OATS FROM FALL AND SPRING APPLICATIONS OF NITRATE OF SODA, AMMONIUM SULFATE AND CYANAMID, USING 30 POUNDS OF NITROGEN PER ACRE

Source and When Applied	1937	Bushels per Acre 1938	1939	1940	Average
Unfertilized	34.0	22.2	28.9	21.2	26.6
Nitrate of Soda—November	65.9	66.2	55.5	50.1	59.4
Ammonium Sulfate—November	64.5	61.4	54.2	49.4	57.4
Cyanamid—November	63.5	63.9	47.4	41.9	54.2
Nitrate of Soda—March	61.8	61.4	66.3	64.6	63.5
Ammonium Sulfate—March	62.9	57.2	65.2	61.5	61.7
Cyanamid—March	56.5	46.5	54.5	43.6	50.3

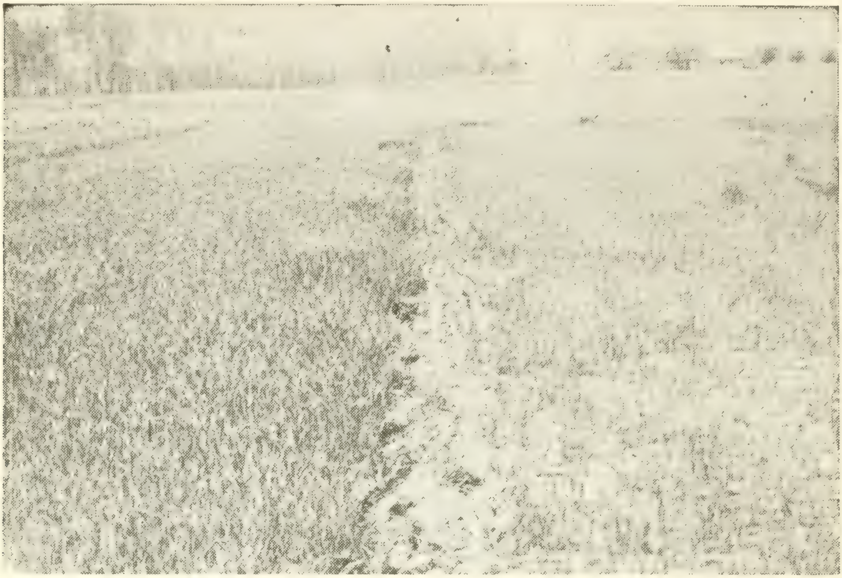

Figure 4—Left: Oats about three weeks after 188 pounds of Nitrate of Soda per acre had been applied. Right: Oats unfertilized.

4.1 bushels more oats were made when nitrate of soda was applied in the spring than when applied in the fall. 4.3 bushels more of oats were made when ammonium sulfate was applied in the spring than in the fall, but 3.9 more bushels were made when cyanamid was applied in the fall than when applied in the spring. Higher yields in 1939 and 1940, however, were obtained from the spring application of all three sources.

SUMMARY AND CONCLUSIONS

Yazoo-Mississippi Delta

The results of 20 years of experimental work with oats at the Delta Branch Experiment Station, consisting of variety comparisons, rates and dates of seeding, sources of nitrogen, rates and dates of applying nitrogen, may be summarized as follows:

1. The highest yielding oat varieties in the tests were the Red Rustproof strains including Ferguson 922, Nortex, Delta Station selection, Hastings' 100 Bushel, Appler, and Baylis. Among the earlier varieties, Coker's Fulgrain, Fulghum, and Kanota have given best yields.
2. October 15 was the best date to sow oats for maximum yields.
3. From 2 to 3 bushels per acre was the best rate to seed oats for maximum yields.
4. 30 pounds of nitrogen per acre from most all the commercial sources of nitrogen more than doubled the yields of oats planted in the fall on Sarpy loam soil of low fertility over an average of 13 years.
5. For an average of 13 years, nitrate of soda produced slightly higher yields than the other sources of nitrogen used.
6. In the Rates of Application experiment, the most economical yield of oats was produced from 30 pounds of nitrogen.
7. March 15 was indicated as the best time to apply nitrogen, from nitrate of soda to produce maximum yields on fall seeded oats.
8. These results indicate that spring applications of nitrate of soda and ammonium sulfate produced slightly higher yields than of fall applications; however, the data are not conclusive as to the best date to apply cyanamid.

OAT INVESTIGATIONS IN HILL SECTIONS OF MISSISSIPPI

Variety Comparisons

Results from recent tests in the hill sections of the state shown in tables 9 and 10 indicate that the Rustproof strains, as has been the case for many years, are the most dependable producers. These strains include Terruf, New Nortex, Appler, Ferguson 922, and Hastings. They are, when properly maintained, practically identical.

The Fulgrains, Victorgrain and Fulghum are earlier than the so-called Rustproof strains and usually produce a little less. They are, however, excellent varieties and should be considered where earliness is required.

Damage from rust was much less in the spring of 1939 and again in 1940 than was the case in the several preceding seasons.

Ordinarily oats planted in the fall will considerably outyield the same variety planted in the spring if winter killing is not great. Stands of oats planted in the fall of 1939 were thinned considerably by the severe winter. The spring of 1940 was abnormally cool and there was very little damage by rust. As a consequence, the yields from spring planted oats compared quite favorably with those from the fall planting.

TABLE 9—OAT VARIETIES, STATE COLLEGE, 1939 AND 1940

	Yield in Bushels per Acre			
		1940		
Variety	1939	Fall	Spring	Average
Ferguson 922	91.7	51.4	50.7	64 6
Terruf	96.7	44.2	49.5	63.5
Hastings	86.0	50.7	51.4	62.7
Appler	88.6	49.2	49.9	62.6
Fulgrain 1	80 9	54.5	51.4	62.3
New Nortex	83.9	51.8	50.7	62.1
Fulgrain 2	87.2	49.3	49.5	62.0
Fulgrain x W. Turf 18-3	85.3	52.9	43.9	60.7
Fulghum	66.4	48.1	46 1	53.5
Kanota	66.8	48.8	43.4	53.0
Fulgrain 3	......	51.0	51.0	......
Fulgrain 4	......	56.9	50.2	......
Victorgrain	......	42 8	52.3	......
Columbia	......	......	43.9	......
Planted	11-25-38	11-30-39	3-6-40	

TABLE 10—OAT VARIETIES, BRANCH STATIONS, 1939 AND 1940

	Yields in Bushels Per Acre								
	Holly Springs			Raymond			Natchez		
Variety	1939	1940	Average	1939	1940	Average	1939	1940	Average
Terruf	17.7	55.0	36.3	39.5	69.7	54.6	53.6	57.5	55.5
New Nortex	17.1	56 4	36.7	34.7	72.2	53.5	53.6	57.8	55.7
Appler	17.2	51.9	34.5	37.8	75.0	56.4	54.4	50.3	53.5
Hastings	16.5	58.4	37.5	37.5	69.9	53 7	52.0	53.3	52.7
Ferguson 922	17.5	54.5	36.0	38.2	69.1	53.7	53.8	51.6	52.7
Ful. x W. T. 18-3	12.8	57.8	35.1	25.6	36.0	30.8	12.3	51.8	32.0
Fulgrain 1	16.2	56.7	36.5	14.8	37.9	26.4	*13.2	44.0	28.6
Fulgrain 2	12.6	52.9	32.7	13.7	35.2	24 4	*15.8	42.9	29.4
Fulghum	13.0	56.0	34.5	16.6	32.3	24.5	*9.5	42.3	25.9
Kanota	9.8	38 0	23.9	16.0	25.0	20.5	*9.8	30.9	20.3
Fulgrain 3	......	57.3	......	......	34.5	......	......	45.5	......
Fulgrain 4	......	52.5	......	......	36.7	......	......	44.1	......
Victorgrain	......	56.2	......	......	53.7	......	......	52.6	......

*Moderate to severe bird damage. This damage affects average.

Rates and Sources of Nitrogen

In the spring of 1940, tests were made with oats in the hill sections of the State including rates and sources of nitrogen applied as a top-dressing. Eight locations, six in the Brown Loam Area and two in the Prairie Belt, were used. These tests included the application of 16 and 32 pounds of nitrogen from nitrate of soda, cyanamid, and ammonium sulfate and consisted of six replications of each treatment at each location. All plots were fertilized on or near the date of March 15.

The approximate cost of these three nitrogenous fertilizers is as follows: nitrate of soda, $36.00 per ton; ammonium sulfate, $36.00 per ton; and cyanamid from $33.50 to $36.00 per ton.

16 pounds of nitrogen is obtained from the following amounts of the indicated materials: nitrate of soda, 100 pounds; ammonium sulfate, 78 pounds; and cyanamid, 72.7 pounds. 32 pounds of nitrogen is obtained from 200 pounds of nitrate of soda, or 156 pounds of ammonium sulfate, or 145.4 pounds of cyanamid.

In seven out of the eight tests as shown in table 11 the application of 16 and 32 pounds of nitrogen from nitrate of soda produced the highest yields. The increase in yield due to 16 pounds of nitrogen from nitrate of soda was slightly lower than the increase in yield as a result of the application of 16 pounds of nitrogen from cyanamid in one test. In another test the application of 32 pounds of nitrogen from ammonium sulfate gave a larger increase than did 32 pounds of nitrogen from nitrate of soda.

The application of 16 pounds of nitrogen from ammonium sulfate gave the second highest increase in yields in all of the tests. The application of 32 pounds of nitrogen from ammonium sulfate produced the second highest increase in yield in six out of the eight tests. On Grenada silt loam on the farm of C. C. Lutz, Canton, Mississippi, 32 pounds of nitrogen from ammonium sulfate was slightly superior to 32 pounds of nitrogen from nitrate of soda. On Bell Clay loam soil the increase in yield as a result of the application of 32 pounds of nitrogen from cyanamid was slightly higher than that produced by 32 pounds of nitrogen from ammonium sulfate.

The increase in yield due to nitrogen from cyanamid was somewhat higher on the terrace and bottom soils, where probably there was more moisture. This is shown by the results in table 5. On the valley test at the Holly Springs Branch Experiment Station the increase in yield due to 16 pounds of nitrogen from cyanamid was slightly higher than the increase from the application of 16 pounds of nitrogen from nitrate of soda.

A weighted average of all tests, table 11, shows that 16 pounds of nitrogen from nitrate of soda increased the yield 16.7 bushels of oats per acre, 16 pounds of nitrogen from cyanamid increased the yield 9.6 bushels per acre, and 16 pounds of nitrogen from ammonium sulfate increased the yield 12.1 bushels per acre. In other words, on the basis of a 16 pound application of nitrogen, 1 pound of nitrogen from nitrate of soda increased the yield 1.04 bushels of oats, 1 pound of nitrogen from cyanamid gave an increase of .60 of a bushel, and 1 pound of nitrogen from ammonium sulfate gave an increase of .75 of a bushel per acre.

The weighted average also shows that 32-pound applications of nitrogen from nitrate of soda, cyanamid, and ammonium sulfate increased the yield 24.6, 13.9, and 20.4 bushels of oats per acre, respectively. Then, on the basis of a 32-pound application of nitrogen per acre, 1 pound of nitrogen from nitrate of soda produced .77 of a bushel, 1 pound of nitrogen from cyanamid produced .43 of a bushel, and 1 pound of nitrogen from ammonium sulfate produced .64 of a bushel.

Using the figures obtained in the weighted average, taking the price of oats

FIGURE 5—AN OAT FIELD IN MADISON COUNTY, MISSISSIPPI

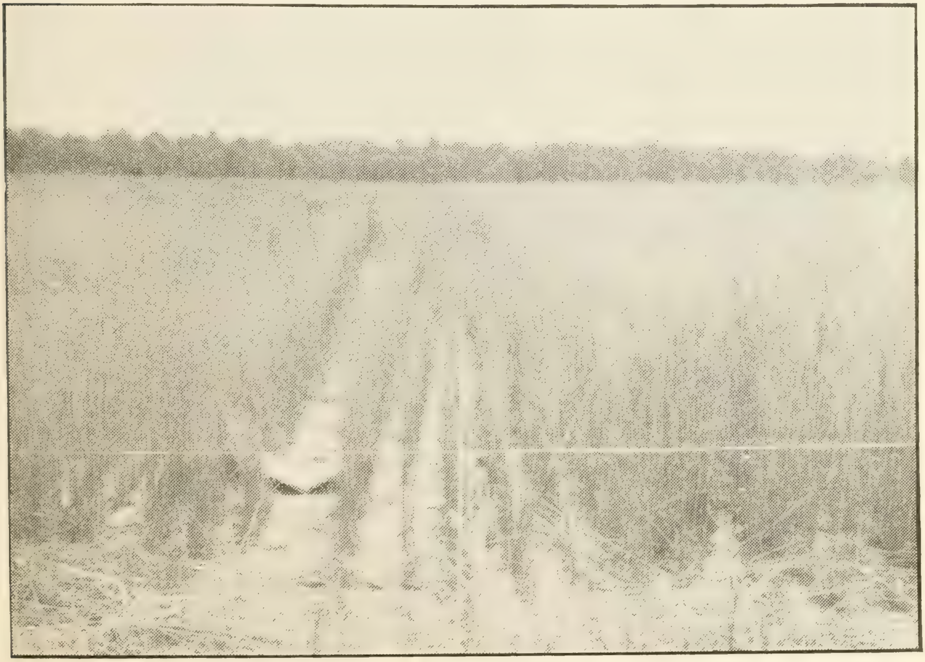

Figure 6—Two plots in the oat test on the H. H. Miller Farm, Madison, Mississippi. The plot on the left received no nitrogen and the plot on the right received 32 pounds of nitrogen from ammonium sulfate (156 pounds of ammonium sulfate) per acre.

TABLE 11—EFFECT OF TOP-DRESSING OATS WITH DIFFERENT RATES AND SOURCES OF NITROGEN

Treatment	Yield in Bushels Per Acre	Increase over no Nitrogen Bushels Per Acre
Howard Green, Canton, Mississippi **Olivier Silt Loam**		
No Nitrogen	37.3	......
16 pounds of nitrogen from nitrate of soda	59.5	22.2
16 pounds of nitrogen from cyanamid	54.4	17 1
16 pounds of nitrogen from ammonium sulfate	56.0	19.7
32 pounds of nitrogen from nitrate of soda	64.4	27.1
32 pounds of nitrogen from cyanamid	58.8	21.5
32 pounds of nitrogen from ammonium sulfate	61.4	24.1
C. C. Lutz, Canton, Mississippi **Grenada Silt Loam**		
No Nitrogen	32.2	......
16 pounds of nitrogen from nitrate of soda	51.2	19.0
16 pounds of nitrogen from cyanamid	41 0	8.8
16 pounds of nitrogen from ammonium sulfate	49.1	16.9
32 pounds of nitrogen from nitrate of soda	59.5	27.3
32 pounds of nitrogen from cyanamid	53.5	21.3
32 pounds of nitrogen from ammonium sulfate	60.4	28.2
Hugh Henderson, Canton, Mississippi **Waverly Very Fine Sandy Loam**		
No Nitrogen	49.4	......
16 pounds of nitrogen from nitrate of soda	65.0	15.6
16 pounds of nitrogen from cyanamid	61.0	11.6
16 pounds of nitrogen from ammonium sulfate	63.6	14 2
32 pounds of nitrogen from nitrate of soda	71.7	22.3
32 pounds of nitrogen from cyanamid	65.6	16.2
32 pounds of nitrogen from ammonium sulfate	70.5	21.1
H. H. Miller Farm, Madison, Mississippi **Grenada Silt Loam**		
No Nitrogen	35.4	......
16 pounds of nitrogen from nitrate of soda	62.3	26.9
16 pounds of nitrogen from cyanamid	42.6	7.2
16 pounds of nitrogen from ammonium sulfate	50 7	8.4
32 pounds of nitrogen from nitrate of soda	68.8	33.4
32 pounds of nitrogen from cyanamid	52.8	17.4
32 pounds of nitrogen from ammonium sulfate	67.8	32.4
Holly Springs Branch Experiment Station, Holly Springs, Mississippi **Grenada Silt Loam, Hill Test**		
No Nitrogen	30.6	......
16 pounds of nitrogen from nitrate of soda	40.0	9.4
16 pounds of nitrogen from cyanamid	34.0	3.4
16 pounds of nitrogen from ammonium sulfate	38.2	7.6
32 pounds of nitrogen from nitrate of soda	49.3	18 7
32 pounds of nitrogen from cyanamid	35.8	5.2
32 pounds of nitrogen from ammonium sulfate	49.0	18.4

TABLE 11 (CONTINUED)—EFFECT OF TOP-DRESSING OATS WITH DIFFERENT RATES AND SOURCES OF NITROGEN

Treatment	Yield in Bushels Per Acre	Increse over no Nitrogen Bushels Per Acre
Holly Springs Branch Experiment Station, Holly Springs, Mississippi Valley Test		
No Nitrogen	31.4	......
16 pounds of nitrogen from nitrate of soda	50.8	19.4
16 pounds of nitrogen from cyanamid	51.7	20.3
16 pounds of nitrogen from ammonium sulfate	42.8	11.4
32 pounds of nitrogen from nitrate of soda	66.4	35.0
32 pounds of nitrogen from cyanamid	40.6	9.2
32 pounds of nitrogen from ammonium sulfate	49.2	17.8
Kahl Farm, Egypt, Mississippi Sumpter Clay Loam		
No Nitrogen	23.6	...
16 pounds of nitrogen from nitrate of soda	32.9	9.3
16 pounds of nitrogen from cyanamid	27.3	3.7
16 pounds of nitrogen from ammonium sulfate	28.0	4.4
32 pounds of nitrogen from nitrate of soda	39.1	12.5
32 pounds of nitrogen from cyanamid	32.4	8.8
32 pounds of nitrogen from ammonium sulfate	34.9	11.3
Kahl Farm, Egypt, Mississippi Bell Clay Loam		
No Nitrogen	38.2	......
16 pounds of nitrogen from nitrate of soda	50.0	11.8
16 pounds of nitrogen from cyanamid	43.0	4.8
16 pounds of nitrogen from ammonium sulfate	46.5	8.3
32 pounds of nitrogen from nitrate of soda	57.7	19.5
32 pounds of nitrogen from cyanamid	50.0	11.8
32 pounds of nitrogen from ammonium sulfate	48.2	10.0
Weighted Average of All Tests		
No Nitrogen	34.8	.
16 pounds of nitrogen from nitrate of soda	51.5	16.7
16 pounds of nitrogen from cyanamid	44.4	9.6
16 pounds of nitrogen from ammonium sulfate	46.9	12.1
32 pounds of nitrogen from nitrate of soda	59.4	24.6
32 pounds of nitrogen from cyanamid	48.7	13.9
32 pounds of nitrogen from ammonium sulfate	55.2	20.4

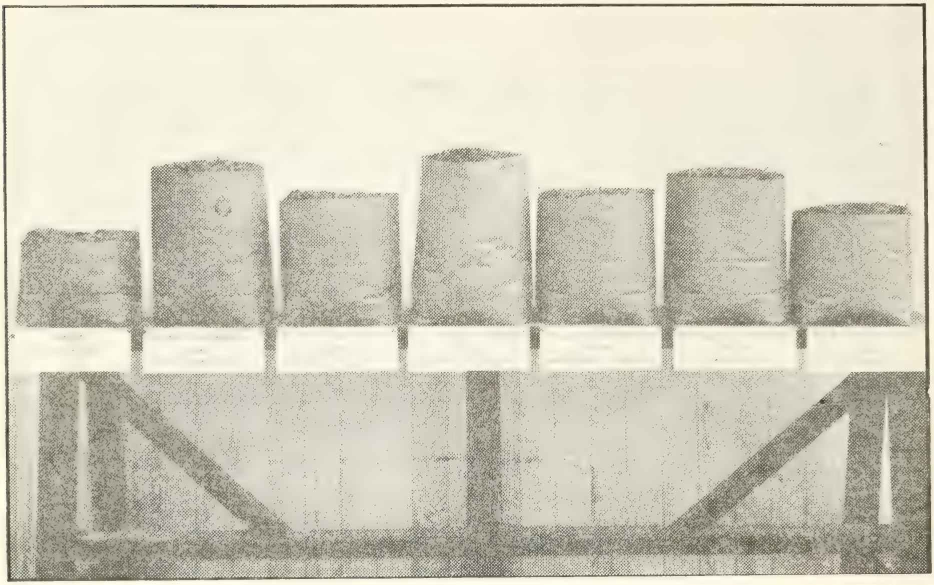

FIGURE 7—A comparison of the yields from a test on the farm of C. C. Lutz, Canton, Mississippi. Left to right: No nitrogen, 32.2 bushels; 200 pounds of nitrate of soda, 59.5 bushels; 100 pounds of nitrate of soda, 51.2 bushels; 156 pounds of ammonium sulfate, 60.4 bushels; 78 pouunds of ammonium sulfate, 49.1 bushels; 145.4 pounds of cyanamid, 53.5; and 72.7 pounds of cyanamid, 41.0 bushels per acre.

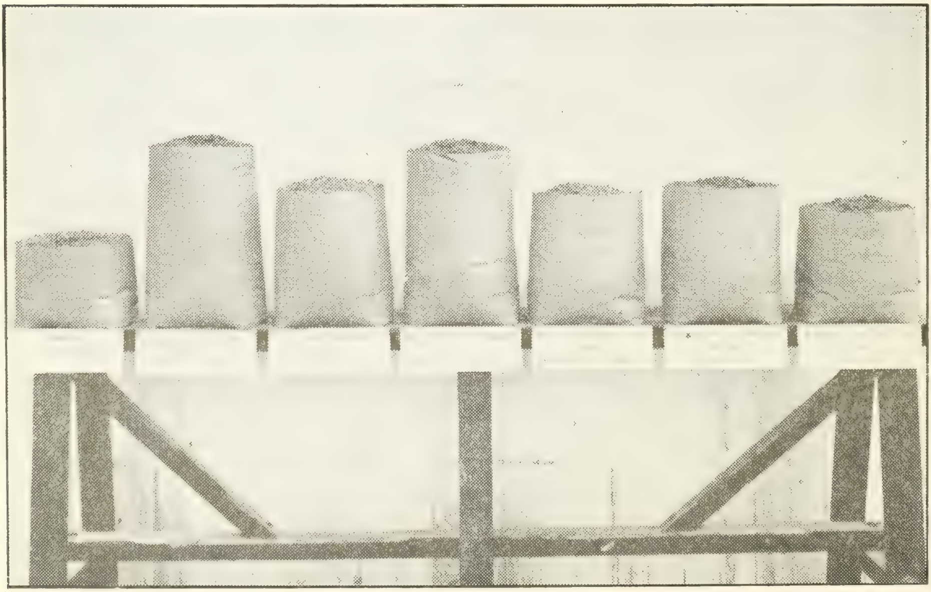

Figure 8—A comparison of the yields from a test on the H. H. Miller Farm, Madison, Mississippi. Left to right: no nitrogen, 35.4 bushels; 200 pounds of nitrate of soda, 68.8 bushels; 100 pounds of nitrate of soda, 62.3; 156 pounds of ammonium sulfate, 50; 145.4 pounds of cyanamid, 52.8; and 72.7 pounds of cyanamid, 42.6 bushels per acre.

to be 30c per bushel and the cost of 16 pounds of nitrogen from nitrate of soda, cyanamid, and ammonium sulfate to be $1.80, $1.22, and $1.40, respectively, the profit per acre from the different sources of nitrogen was calculated. These calculations showed a profit of $3.21 per acre when 16 pounds of nitrogen from nitrate of soda was applied per acre, $1 66 when 16 pounds of nitrogen from cyanamid was used, and $2.23 when 16 pounds of nitrogen from ammonium sulfate was applied. By calculating in the same manner, a profit of $3.78 per acre was obtained when 32 pounds of nitrogen from nitrate of soda was applied, a profit of $1.73 per acre when 32 pounds of nitrogen from cyanamid was applied and a profit of $3.32 per acre was secured when 32 pounds of nitrogen from ammonium sulfate was applied.

Using the figures in the weighted average, taking the price of oats to be 30c per bushel and the cost of 16 pounds of nitrogen from nitrate of soda, cyanamid, and ammonium sulfate to be $1.80, $1.22 and $1.40, respectively, the net return per dollar invested in nitrogenous materials was calculated. These calculations show a net return of $1.78 per dollar invested when 16 pounds of nitrogen from nitrate of soda was applied per acre, a net return of $1.36 per dollar invested when 16 pounds of nitrogen from cyanamid was used, and a net return of $1.45 per dollar invested when 16 pounds of nitrogen from ammonium sulfate was used. Calculating in the same manner, a net return of $1.05 per dollar invested was obtained when 32 pounds of nitrogen from nitrate of soda was applied, $0.71 per dollar invested when 32 pounds of nitrogen from cyanamid was applied, and $1.19 per dollar invested when 32 pounds of nitrogen from ammonium sulfate was applied.

Effect of Nitrogen, Phosphorus and Potassium on the Yield of Oats

In 1935 fertilizer tests were begun with spring-sown oats using different analyses of fertilizer. The rate of fertilization was 400 pounds and the different analyses were 4-8-4, 0-8-4, 4-8-0, 4-0-4, and one plot in each series was left unfertilized. In 1937 the tests with spring-sown oats was discontinued and tests with fall-sown were started on the same plots. These tests were fertilized as follows: 400 pounds 4-8-4, 400 pounds 0-8-4 followed by a top-dressing the next spring with 16 pounds of nitrogen, 400 pounds 4-8-0, 400 pounds 4-0-4, and no fertilizer. The results of these tests are shown in table 12 and table 13.

Although all of these tests were located in Lowndes County, the soil series represented are prevalent throughout the Coastal Plains region. On the hills, the tests were located on Ruston and Savannah series; and on the terrace or benchland the tests were located on Cahaba and Kalmia series.

The data on fall oats, table 12, show the plot treated with 400 pounds of 0-8-4 in the fall when the oats were seeded and then top-dressed in March with 16 pounds of nitrogen (100 pounds of nitrate of soda) per acre, consistently produced higher yields than the plot treated with 400 pounds of 4-8-4 at the time oats were seeded. Slight increases were obtained in every case from the application of 32 pounds of P_2O_5 (160 pounds of 20% superphosphate) per acre. Very small increases were obtained from applying potash.

The data on spring-sown oats, table 13, show very little response to applications of phosphorus or potash when nitrogen was not applied. There are only small differences in yields on the plots receiving 400 pounds of 4-8-4, 400 pounds of 4-8-0, and 400 pounds of 4-0-4. This indicates that nitrogen is largely responsible for increased yields on spring-sown oats.

The weighted average of the fall-seeded tests shows that the plot treated with 400 pounds of 0-8-4 in the fall and followed by a top-dressing in the spring with 16 pounds of nitrogen gave a yield of 27.3 bushels per acre, as com-

TABLE 12—THE EFFECT OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON THE YIELD OF FALL-SOWN OATS

Treatment	T. F. Richards Columbus, Mississippi Savannah fine sandy loam	D. E. Egger Caledonia, Mississippi Kalmia fine sandy loam	S. E. Bryant Columbus, Mississippi Ruston fine sandy loam	H. G. Betts Caledonia, Mississippi Cahaba fine sandy loam	Bob Egger Caledonia, Mississippi Savannah fine sandy loam	Weighted Average of all tests	Increase over No Fertilizer For all tests
3-Year Average Yield in bushels per acre							
400 pounds 4-8-4	26.1	18.7	32.7	18.1	20.3	23.2	11.2
400 pounds 0-8-4*	31.3	23.2	34.3	20.1	27.8	27.3	15.3
400 pounds 4-8-0	27.7	20.9	31.2	16.1	20.2	23.2	11.2
400 pounds 4-0-4	19.3	11.6	25.0	13.4	15.5	17.0	5.0
No fertilizer	11.0	9.0	22.3	8.3	9.3	12.0	

*Top-dressed March 15 with 16 pounds of nitrogen (100 pounds of nitrate of soda) per acre.

TABLE 13—THE EFFECT OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON THE YIELD OF SPRING-SOWN OATS

Treatment	D. E. Egger Caledonia, Mississippi Kalmia fine sandy loam	S. E. Bryant Columbus, Mississippi Ruston fine sandy loam	H. G. Betts Caledonia, Mississippi Cahaba fine sandy loam	Bob Egger Caledonia, Mississippi Savannah fine sandy loam	Weighted Average of all tests	Increase over No Fertilizer for all tests
2-Year Average Yield in bushels per acre						
400 pounds 4-8-4	20.6	19.6	23.1	23.3	21.7	11.2
400 pounds 0-8-4	10.9	9.3	11.1	14.6	11.5	1.0
400 pounds 4-8-0	20.6	18.9	18.3	25.2	20.8	10.3
400 pounds 4-0-4	19.7	16.1	19.6	17.6	18.3	7.8
No Fertillizer	11.5	8.8	9.0	12.5	10.5	

pared with a yield of 12.0 bushels per acre on the no fertilizer plots. This is an increase in yield of 15.3 bushels of oats per acre as a result of the fertilizer treatment. The application of 32 pounds of P_2O_5 (160 pounds of 20% superphosphate) increased the yield 6.2 bushels per acre. On plots receiving the identical fertilizer treatment of 400 pounds of 4-8-4 per acre, top-dressing with 16 pounds of nitrogen in the spring instead of applying at planting time resulted in an increase in the yield of 4.1 bushels of oats per acre.

The weighted average of the spring-seeded oat tests shows a definite response to nitrogen applications but very little response to applications of phosphorus and potash. The application of 400 pounds of 4-8-4 produced a yield of 21.7 bushels per acre as compared with a yield of 10.5 bushels on the no fertilizer plot, while the application of 400 pounds of 0-8-4 produced a yield of only 11.5 bushels per acre.

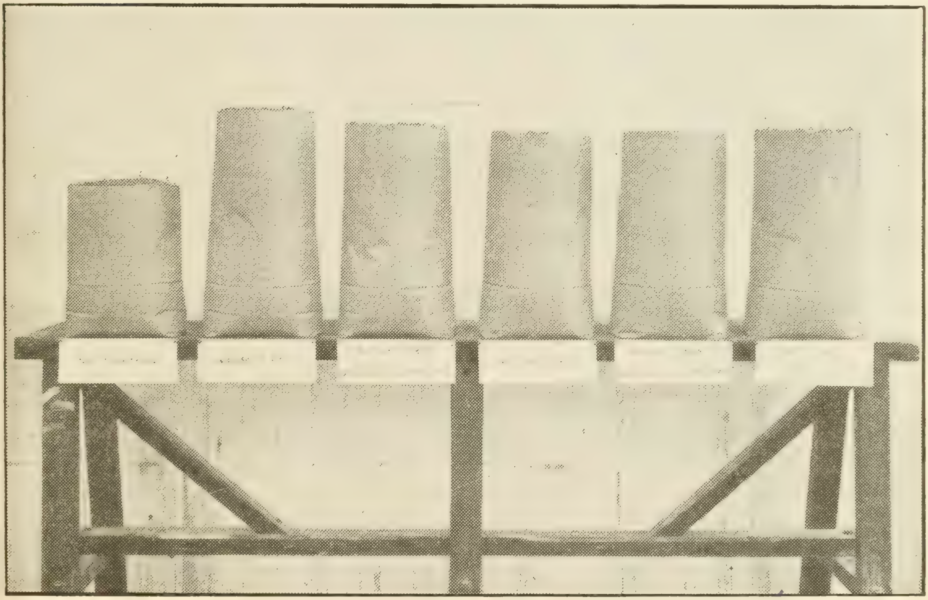

Figure 9—The effect of a crop of lespedeza cut for hay on the yield of oats top-dressed with 24 pounds of nitrogen. From left to right: lespedeza not fertilized and oats not top-dresses, 50 bushels; lepedeza 400 pounds of 0-8-0, 76 bushels; lespedeza, 400 pounds of 0-8-0 using basic slag as the source of phosphorus, 71 bushels; lespedeza, 400 pounds of 0-8-8, 69 bushels; lepedeza, 400 pounds 0-8-8 using basic slag as source of phosphorus, 70 bushels; lespedeza not fertilized, 71 bushels of oats per acre.

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Rotation of Lespedeza, Crotalaria and Soybeans with Oats

During the summer of 1939, a test was started at the Raymond Branch Experiment Station, Raymond, Mississippi, to study the effect of lespedeza, crotalaria and soybeans on the yield of the oat crop which followed. Varying analyses of fertilizer were placed under the different legumes, and all plots except a check series were top-dressed March 15 with 24 pounds of nitrogen per acre from nitrate of soda.

A strain of Texas red rustproof oats was seeded in the Fall. The soybeans and crotalaria were turned under prior to the oat seeding, whereas the lespedeza was cut for hay and the land was not broken on the lespedeza plots before seeding to oats. The plots were 1/40 acre in size and there were four series for each treatment.

The results herein reported are for only one year but it is the present plan to continue this test until 5 years' results have been obtained.

That nitrogen applied during the Spring is the chief factor in increasing oat yields in the Brown loam region of Mississippi is shown by table 14 and figures 9 and 10, in which 32 pounds of P_2O_5 from superphosphate alone or in combination with 32 pounds of K_2O (potash) failed to produce more oats than no fertilizer under the lespedeza followed by 24 pounds of nitrogen applied as a top-dressing during March.

There were no check plots for the crotalaria and soybeans where nitrogen was not added during March, but from the yields on plots having oats continuously with and without nitrogen it is reasonable to assume that part of the 9 and 12 bushels per acre increases over the lespedeza plots for crotalaria and soybeans, respectively, are due to the additional nitrogen obtained by turning them under; the lespedeza was cut for hay.

It is interesting to note that the lespedeza did not depress the yield of oats and yet produced a good crop of hay.

Although the yield of oats on the lespedeza plots was about 9 bushels per acre less than on the crotalaria and soybean plots, a good crop of hay is worth considerably more than 9 bushels of oats. Therefore, from the standpoint of land use and based on

TABLE 14—THE EFFECT OF SUMMER LEGUMES AND THEIR FERTILIZER TREATMENT ON THE YIELD OF OATS TOP-DRESSED WITH 24 POUNDS OF NITROGEN.

Treatment	Yield of Oats bushels per acre
Oats continuously—not top-dressed	45.0
Oats following corn—oats top-dressed	68.0
Lespedeza unfertilized and cut for hay—oats not top-dressed	50.0
Lespedeza fertilized with 400 pounds 0-8-8 and cut for hay—oats top-dressed	69.0
Lespedeza fertilized with 400 pounds 0-8-0 and cut for hay—oats top-dressed	76.0
Lespedeza unfertilized and cut for hay—oats top-dressed	71.0
Crotalaria unfertilized and turned under—oats top-dressed	80.0
Crotalaria fertilized with 400 pounds 0-8-8 and turned under—oats top-dressed	81.0
Crotalaria fertilized with 400 pounds 0-8-0 and turned under—oats top-dressed	88.0
Tokio soybeans unfertilized and turned under—oats top-dressed	83.0
Tokio soybeans fertilized with 400 pounds 0-8-8 and turned under—oats top-dressed	83.0
Tokio soybeans fertilized with 400 pounds 0-8-0 and turned under—oats top-dressed	77.0

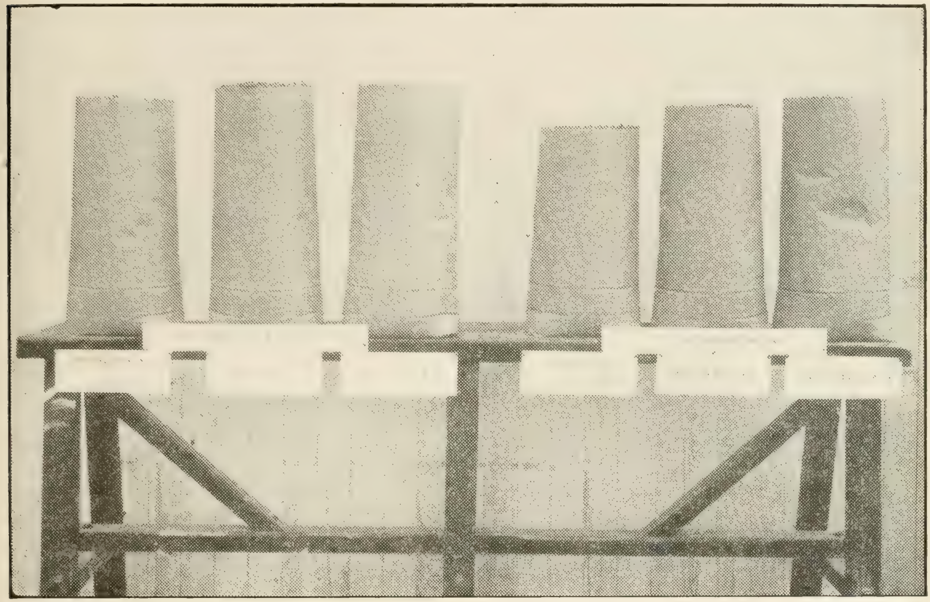

FIGURE 10—Fertilizer applied under crotalaria and soy beans, which were turned under, followed by oats top-dressed with 24 pounds of nitrogen from nitrate of soda.

these results, the lespedeza-oat rotation is superior to the crotalaria and soybean-oat rotations.

The increase in the yield of oats per pound of nitrogen applied is slightly less than 1 bushel following lespedeza and is a little more than 1 bushel following crotalaria and soybeans.

SUMMARY AND CONCLUSIONS

Hill Sections of Mississippi

The results of from 1 to 5 years of experimental work with oats conducted by the Mississippi Experiment Station in the hill sections of the state, consisting of variety comparisons, fertilizers for fall-sown and spring-sown oats, rates and sources of nitrogen, and a rotation study including legumes and oats, may be summarized as follows:

1. Results indicate that the Rustproof strains are the most dependable producers. These strains include Terruf, New Nortex, Appler, Ferguson 922, and Hastings. The Fulgrains, Victorgrain and Fulghum are among the best of the earlier-producing varieties.

2. Fall-sown oats give higher yields than spring-sown.

3. Applications of nitrogen are necessary if high yields are to be obtained, and March 15 appears to be the best date to apply this needed nitrogen.

4. On eight tests conducted in areas where most of the oats in the hill sections are grown nitrate of soda produced higher yields than ammonium sulfate or cyanamid.

5. The tests mentioned above also indicate that 16 pounds of nitrogen is the most economical rate. The application of 16 pounds of nitrogen from nitrate of soda (100 pounds of nitrate of soda) increased the yield 50 per cent.

6. One year's results obtained from a rotation study of summer legumes with oats at the Raymond Branch Experiment Station show that 24 pounds of nitrogen from nitrate of soda applied in March produced an increase in yield of oats of 20 bushels per acre following lespedeza which was cut for hay and 30 bushels per acre following crotalaria and Tokio turned under.

An oat crop removes a considerable amount of plant food from the soil as shown by yields from the unfertilized and fertilized check plots in the fertilizer experiments. Successful oat production is therefore dependent upon high yields, secured either by commercial fertilization or the use of legumes turned under.

It is a practice in several parts of the delta to sow oats on land on which soybeans have been combined for grain production or turned under after the seed have matured, thereby obtaining a volunteer crop of soybeans in the oats before they are combined the next spring. Under another practice alsike or sweet clover is planted, the oats are combined in the spring, the clover cut for hay during the summer, and the stubble allowed to grow the following winter when it is turned under for soil improvement. There is also a possibility of maintaining soil fertility in the Yazoo-Mississippi delta by seeding bur clover with the oats and permitting the clover to mature seed for a succeeding winter crop to be turned under for soil improvement.

In the hill section of the state data in this bulletin show that lespedeza cut for hay or soybeans or crotalaria turned under are defective in maintaining soil fertility and increased oat yield.

If there is sufficient moisture in the soil, a crop of soybeans, cowpeas, sagrain, sudan grass or corn may be produced following an oat crop. Experiments are under way at State College and at Stoneville to determine what crops may be produced most profitably after oats, and yields that may be expected of such crops under average seasonal conditions.

Oat Smut. Controlling oat smut is an important problem. A simple method is to sprinkle a mixture of one pint of formaldehyde and ten gallons of water to 40 to 80 bushels of grain, turning them thoroughly with a shovel as they are being sprinkled. After sprinkling, the oats should be covered with clean sacks and planted as soon as possible.

Army Worm. Probably the most important insect attacking small grains is the army worm, Cirphis unipuncta (Haworth). The winter is passed mainly in the partly grown larvae stage. These larvae shelter in the soil about clumps of grasses or small grains, or under litter on the ground. They begin feeding early in the spring and develop moths which deposit their eggs for the first generation around the latter part of April or the first part of May. Within a few days the eggs hatch, producing young worms green in color which have a looping habit of crawling until about half grown. They may often be found by the thousands in fields of grass or small grains, and because of their habit of feeding at night, their presence is generally not suspected until the crop is nearly destroyed. When the feed supply becomes exhausted in the fields where they have developed, the caterpillars move out in hordes or armies and attach near-by fields. When these worms become full grown they are nearly two inches long, of a dark green color, with a narrow broken stripe down the coster of the back and three light stripes on the sides, the lower one being of a yellowish shade. In the delta this generation pupates about the middle of May and the moths emerge within about two weeks.

The approved method of controlling the army worm is to poison them by scattering broadcast a poison-bran mixture in the fields of oats where they are feeding, or across the line of march of worms when they are leaving the fields where food has become scarce. A very good bait for this purpose is as follows:

25 pounds of dry wheat bran
3 gallons of water
2 quarts of cheap molasses
1 pound of sodium arsenite or Paris green, or white arsenic.

A satisfactory kill may be expected when the bait is used in oats at the rate of 12 pounds to the acre.

Bulletin No. 349 **October, 1940**

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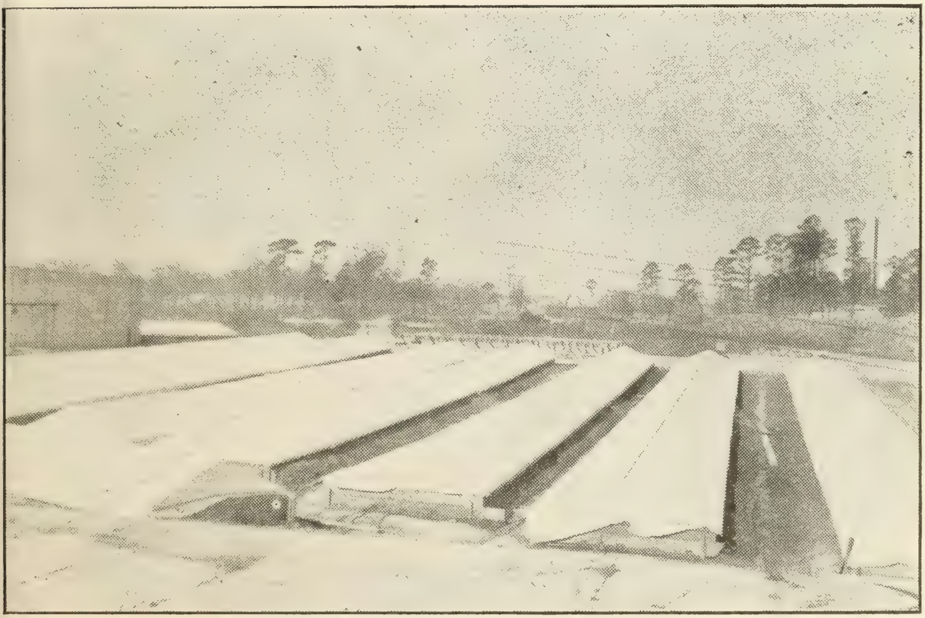
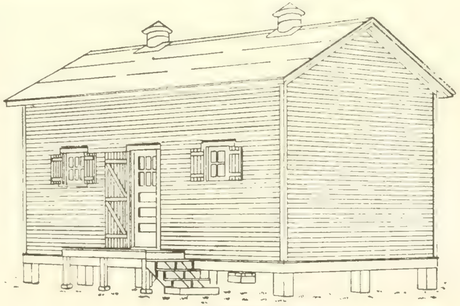
Sweetpotato Plant Production in Mississippi



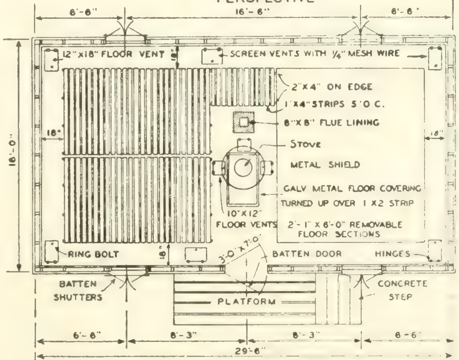
Mississippi Agricultural Experiment Station

CLARENCE DORMAN, Director

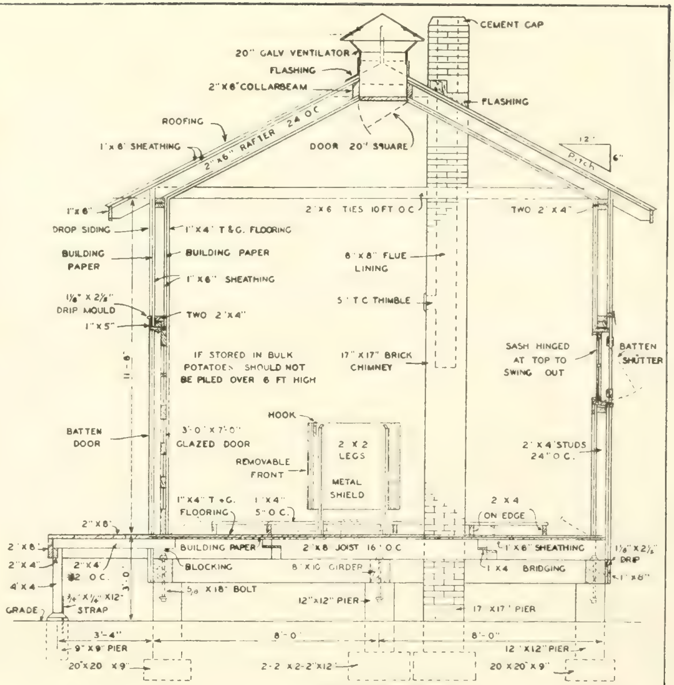
State College, Mississippi



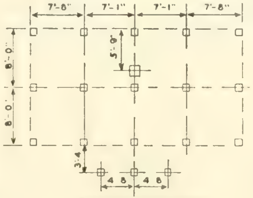
PERSPECTIVE


6'-6"
16'-6"
6'-6"
12"x18" FLOOR VENT
SCREEN VENTS WITH 1/4" MESH WIRE
2"X4" ON EDGE
1"X4" STRIPS 5" O C.
8"X8" FLUE LINING
STOVE
METAL SHIELD
GALV METAL FLOOR COVERING TURNED UP OVER 1 X2 STRIP
10"X12" FLOOR VENTS
2'-1" X 6'-0" REMOVABLE FLOOR SECTIONS
18"
18"
18"
16'-0"
RING BOLT
3'-0"x7'-0"
BATTEN DOOR
HINGES
BATTEN SHUTTERS
PLATFORM
CONCRETE STEP
6'-6"
8'-3"
8'-3"
6'-6"
29'-6"

PLAN
SCALE 1/4" = 1'-0"


CEMENT CAP
20" GALV VENTILATOR
FLASHING
2"X6" COLLARBEAM
FLASHING
ROOFING
1"x 6" SHEATHING
2"x6" RAFTER 24" O C
DOOR 20" SQUARE
12"
Pitch
6"
1"x 6"
DROP SIDING
BUILDING PAPER
1/8" X 2 1/2" DRIP MOULD
1" x 5"
1"X4" T & G. FLOORING
BUILDING PAPER
1"X6" SHEATHING
TWO 2"X4"
2"x6 TIES 10 FT O C
8"x8" FLUE LINING
5" T C THIMBLE
17"X17" BRICK CHIMNEY
TWO 2"x4"
IF STORED IN BULK POTATOES SHOULD NOT BE PILED OVER 6 FT HIGH
SASH HINGED AT TOP TO SWING OUT
BATTEN SHUTTER
11'-8"
BATTEN DOOR
3'-0" x 7'-0" GLAZED DOOR
HOOK
REMOVABLE FRONT
2 X 2 LEGS
METAL SHIELD
2" x 4 STUDS 24" O C.
1"X4" T+G. FLOORING
1"X4" 5" O C.
2 X 4 (ON EDGE)
2"X8"
2"X8"
2"X4"
4'X4
GRADE
2"X4" 32" O C.
3'-0"
3/4" X 1/4" X12" STRAP
BUILDING PAPER
BLOCKING
5/8" X18" BOLT
2"X8" JOIST 16" O C
8"X10" GIRDER
12"x12" PIER
1"x 6" SHEATHING
1 X4 BRIDGING
17"X17" PIER
1/8" X 2 1/2" DRIP
1"x8"
3'-4"
9"X9" PIER
20"X20 X9"
8'-0"
2-2 X2-2"X12"
8'-0"
12"X12" PIER
20 X 20" X 9"

CROSS SECTION
SCALE 1/2" - 1'-0"


7'-8"
7'-1"
7'-1"
7'-8"
8'-0"
8'-0"
5'-0"
3'-4
4 8
4 8

FOUNDATION PLAN
SCALE 1/4" - 1'-0"

BILL OF MATERIALS

CONCRETE. MIX 1: 2 1/2 5
19 - BAGS CEMENT , 1 3/4 - CU YDS. SAND, 3 1/2 - CU YDS GRAVEL
CHIMNEY
700 - BRICK 1 - 5" T C THIMBLE 6 - SQ FT GALV FLASHING
6 FC 8 X8 FLUE LINING 4 BAGS CEMENT 1/2 - CU YD SAND

LUMBER AND MISCELLANEOUS:
6 - 8"X10"X16'-0" GIRDERS
2 - 4"X10"X16'-0" END GIRDER
1 - 4"X4"X12'-0 PLATFORM
2 - 2"X10"X12'-0 STEPS
8 - 2"x 6"x 10'-0 PLATFORM
5 - 2"x 8 x 12' 0 HEADERS + BARGES
25 - 2" X 8" X 16'-0 JOIST
32 - 2" X 6" X 12'-0 RAFTERS
HARDWARE FOR SHUTTERS + DOORS
6 - GAL PAINT , 7 SQ ROOFING

20 - 2"X4" X18'-0" PLATES TIES
100 - 2"X4" X12'-0 STUDS ETC
1 - 2" X2" X12' 0" SHIELD LEGS
8 - 1" x 8" x 16'-0" BASE + RIDGE
5 - 1" x 6" x 16'-0" FASCIA
8 - 1 1/8 x 4" x 14'-0" COR BDS
65 - 1 X 4" X 12'-0" SLATS + BRG
8 - 1" X 3" X 12'-0 BARGE TRIM
GALV SHIELD + FLOOR COVERS
25 LBS 6D COM NAILS , 100 LBS 8D CAS NAILS, 150 LBS 8D COM 50 LBS 16D CC

8 - 1 X 4 1/2" X 8'-0" WINDOW + DOOR TRIM
100 - LIN FT 1 1/4 X2 DRIP MOULD
6000 - FT BM 1"x 6" SHEATHING
1500 - FT BM 6" DROP SIDING
2200 - FT BM T.+G FLOORING
8 - ROLLS BUILDING PAPER
1 - 3'-0" X 7'-0" X1 3/4" DOOR GLAZED 6 LIGHTS
WITH FRAME AND HARDWARE
4 - SASH 6 LIGHTS 9" X12"
WITH FRAMES AND HARDWARE
15 - 5/8" X18" ANCHOR BOLTS
2 - 20" DIAMETER GALV VENTILATORS
6 - 12"X18" FLOOR VENTS + HARDWARE
3 - 10" X18" " " " "
3 - 1/4" X1 1/4" X 12" STRAPS

CAPACITY APPROX 1000 BUSHELS

COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
MISSISSIPPI STATE COLLEGE
AND U S. D A COOPERATING

SWEET POTATO HOUSE

DRAWN BY
EXT AGRL ENG
BLUE PRINT DEPT

Sweetpotato Plant Production

By W. S. ANDERSON, Associate Horticulturist,
Mississippi Agricultural Experiment Station

In the production of sweetpotato plants the essentials to success are good seed stock, suitable propagating beds, suitable bedding medium, proper bedding methods, and proper attention to pulling and care of the plants. In this bulletin brief consideration is given to each of these essentials. The information is designed to be of practical benefit to Mississippi growers.

GOOD SEED STOCK

Disease Freedom

Seed stock sweeetpotatoes should be produced so as to be free of all diseases which cause decay losses during storage and low production of plants in the beds. The best way to be assured of this is to use vine cuttings for growing the seed crop and set these cuttings on disease-free land. If new land is available, it is by all means preferred; but if it is not available, use land that has not grown a crop of sweetpotatoes in at least five years. The diseases which cause sweetpotato rots live only on sweetpotatoes, and if this crop is not grown on the land for several years the diseases die.

Seed Size

The roots kept for seed should be the small sizes from high producing hills. The work of many investigators as well as the experience of growers show that the small roots produce more plants per bushel than the large roots. During 1935, 1936 and 1937 work was done by this station to compare the sprouting of roots 1 to 1½ inches thick and those 2 to 3½ inches thick. The Triumph variety was used in these experiments and the yielding ability of the plants from the two sizes of seed stock was compared. The results of these experiments are presented briefly in tables 1, 2, and 3.

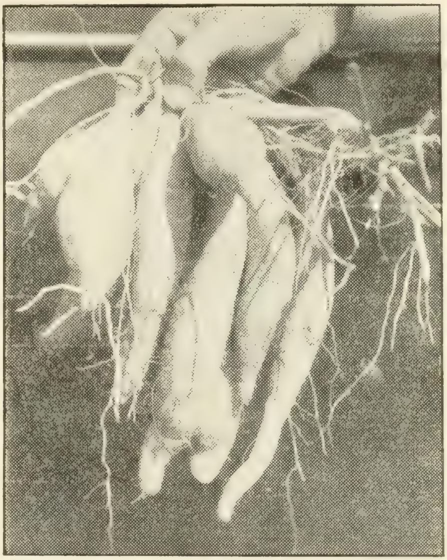


FIGURE 1—GOOD SEED STOCK ROOTS

These data show that while there were more plants produced per root by the larger seed, these plants were not significantly larger than those produced by the smaller seed. Almost twice as much weight of root of the larger seed was required to produce a plant as of the smaller seed. The small seed produced more plants per bushel early in the season and for the entire season than the large seed. While the difference of 312 plants per bushel may seem small, it is a significant difference. It means that one fourth less seed stock of the small size need be bedded for a given number of plants, or that one fourth more plants will be produced by the small seed.

Figure 1 shows a good hill of Triumph seed size roots. This hill contains 10 roots, each approximately 1 inch in thickness. It came from a field of vine cuttings set June 5 after an oat crop, and dug October 27, yielding approximately 150 bushels per acre.

Harvest Date

Sweetpotatoes that are to be used for seed should by all means be harvested before any frost occurs. Results of experiments by Lauritzen (3) show that sweetpotatoes do not need to be frozen or "frost bitten" to be injured so that little or no sprouting occurs. If they are chilled by temporary exposure to temperatures below 40°F. they may not sprout. The roots do not freeze until their temperature reaches 29° F.. When the vines are injured by frost the roots are likely to be chilled so that although they do not rot in storage, they may be useless as seed stock.

Handling Seed Stock

Experiments were conducted by this station in 1935 and 1936 in which two lots of 7 bushels each of the Triumph variety were handled during harvest so that bruising of the roots was more severe in one lot than in the other. The roots of one lot were placed into crates directly from the plowed-up row and designated "carefully" handled, while in the other lot the roots were thrown from three adjacent rows into the center row forming a "heap" row, and then taken up into crates. This lot was designated "commercially" handled, because many growers harvest their crops in this way.

Methods Compared

The two lots were placed in a good storage house and the temperature kept at approximately 85° F. for 12 days. The temperature was maintained at approximately 55° F. after curing until bedding time. Both lots were weighed and examined for rots at the end of the curing period, at two 30-day intervals during storage and at the end of the storage period.

The data in table 4 show that the differences in shrinkage between the two lots were very striking for all periods of storage. "Carefully" handled sweetpotatoes shrank only 16.67 percent, while those "commercially" handled shrank 26.28 percent. There was more shrinkage of both lots during the curing period and the first month thereafter than later. This was to be expected because effective curing reduces water loss. Because of this effective curing also, the amount of rots was so small as to be unimportant and was about the same in both lots.

Value of Careful Handling

The data on plant production is shown in tables 5 and 6. The difference of 1354 plants per bushel in favor of the "carefully" handled lot is very striking. "Carefully" handled seed stock produced over twice as many plants per bushel Of even greater importance to growers is the difference between the two lots in the production of early plants. Figure 2 shows the appearance of the two lots in the bed at the time of the first pulling of plants. From table 6 it is noted that in the first three pullings 766 plants were obtained from the carefully handled lot and only 201 from the "commercially" handled lot.

If the grower produces plants for sale, the additional 565 plants obtained from the "carefully" handled lot would greatly affect his profit because of the higher price usually received for early plants. The price per thousand plants is usually reduced as the season advances, so that the last three pullings shown in the table might be considered as having no sale value.

These results indicate a saving to the grower in storage and bedding space needed for production of early plants. Furthermore, they indicate a direct increased profit to the grower who produces plants for setting on his own farm. The commercial grower would ordinarily set plants from the first five pullings in table 6. If so, he would be able to set 11,180 plants or about one acre from 10 bushels of "carefully" handled seed, and only 4,780 plants or

TABLE 1—EFFECT OF SIZE OF SEED STOCK ON PLANT PRODUCTION OF THE TRIUMPH SWEETPOTATO; SUMMARY OF THREE YEARS RESULTS

Seed Size	No. Plants Per Root			Grams Root Per Plant			No. Plants Per 60 lb. Bushel		
	1935	1936	1937	1935	1936	1937	1935	1936	1937
Large	12.7	15.8	5.2	22.4	21.6	54.1	1215	1255	502
Small	6.6	8.3	4.1	17.5	12.4	23.6	1612	2190	1152
Difference	6.1	7.5	1.1	4.9	9.2	20.5	397	935	650

TABLE 2—EFFECT OF SIZE OF SEED STOCK ON EARLINESS OF SPROUTING AND TOTAL PLANT PRODUCTION OF THE TRIUMPH SWEETPOTATO, 3-YEAR AVERAGE

Seed Size	Plants Produced Per Bushel by 10-Day Periods			Total Plants
	1	2	3	Per 60 lb. bu.
Large	219	243	383	845
Small	256	265	636	1157
Difference in favor of small seed	37	22	253	312

TABLE 3—EFFECT OF SIZE OF SEED STOCK ON YIELD OF THE TRIUMPH SWEETPOTATO; 2-YEAR AVERAGE

Plot Pair	Seed Size	Yield Per Acre in 60 lb. bu.				
		Jumbo	No. 1	No. 2	Culls	Total
1.	Large	62	195	28	19	304
	Small	49	194	31	12	286
2.	Large	11	217	25	14	267
	Small	29	215	25	13	282
3.	Large	15	203	26	26	270
	Small	12	202	19	21	254
4.	Large	40	195	29	21	285
	Small	47	159	32	17	265
Average	Large	27	202	27	20	276
	Small	34	192	27	15	268

TABLE 4—INFLUENCE OF HANDLING SWEETPOTATOES ON LOSS IN WEIGHT DURING STORAGE—AVERAGE OF TWO YEARS' RESULTS

Treatment	Per Cent Loss in Weight During Various Periods					Per Cent Rots by Weight
	Curing	First	Second	Third	Entire	
“Carefully” handled	6.69	1.59	1.73	1.40	16.67	0.77
“Commercially” handled	11.58	3.66	2.68	2.51	26.28	1.38
Difference in favor of “Carefully” handled	4.89	2.07	0.95	1.11	9.61	0.61

TABLE 5—INFLUENCE OF HANDLING SWEETPOTATOES ON PLANT PRODUCTION—AVERAGE OF TWO YEARS RESULTS

Treatment	Plants per Root	Weight of Plants (grams)	Plants per 60 pound Bushel
“Carefully” handled	12.83	5.15	2371
“Commercially” handled	7.32	5.39	1017
Difference in favor of “carefully” handled	5.51	—0.24	1354

about one-third of an acre from 10 bushels of "commercially" handled seed. This means that a grower would need to bed 30 bushels of "commercially" handled seed to be sure of producing enough plants to set an early acre.

The grower who practices "careful" handling can expect to have higher yields, because of the assurance that he will be able to set plants early. Experiments in the coastal section of South Carolina (2) have shown that successive 2-week delays in planting from May 15 to July 15 result in successively lower yields for the respective plantings of approximately 30 bushels of No. 1's and 50 bushels total per acre per 2-week interval. The July 15 plantings yielded only one-third as many bushels of No. 1 grade and total of all sizes as did the May 15 plantings.

Decreases in percentage of No. 1's were less striking than loss in bushels of No. 1's in delayed planting. Late planting very markedly decreased the yield and percentage of Jumbos and increased the percentage of No. 2 grade. Similar results can be expected from sections of Mississippi where sweetpotatoes are grown.

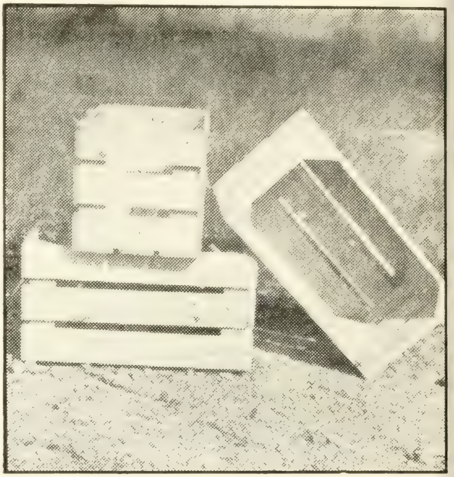


FIGURE 5—FIELD AND STORAGE CRATES

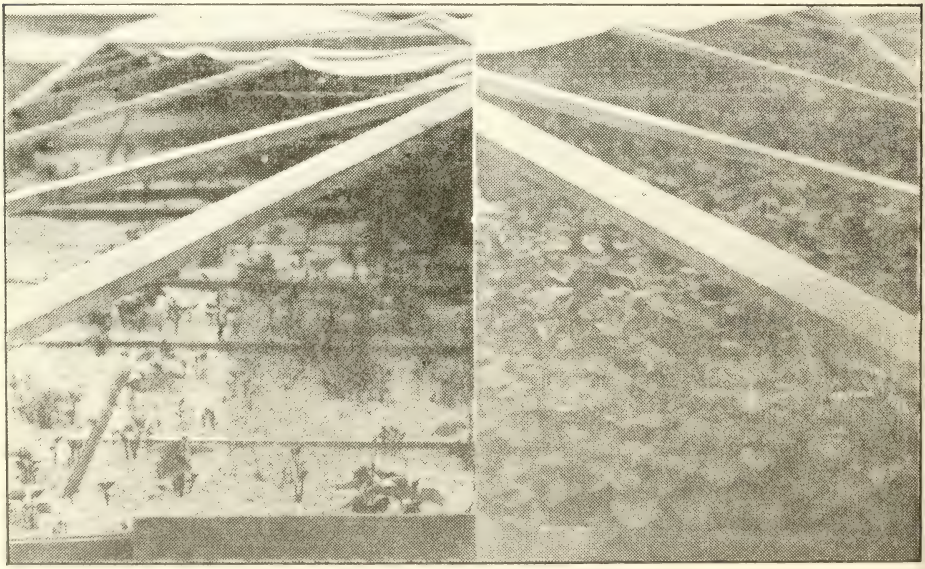


Figure 2—Effect of handling seed stock on plant production. "Commercially" handled lot at left, "Carefully" handled at right. Photographed on day of first pulling from "Carefully" handled lot, four weeks from date of bedding.

TABLE 6—INFLUENCE OF HANDLING SWEETPOTATOES ON EARLINESS OF SPROUTING, 1936

	No. of Plants per 60 lb. bu. Seed at Various Pullings									
	1	2	3	4	5	6	7	8	9	Total
"Carefully" handled	269	213	284	160	192	137	139	158	185	1737
"Commercially" handled	0	65	136	125	152	109	135	127	135	984
Difference in favor of "carefully" handled	269	148	148	35	40	28	4	31	50	753

Curing and Storing

The object of curing sweetpotatoes is to heal wounds as quickly as possible and hasten the thickening of the skin to give protection against rot fungi. Wounds heal most rapidly at temperatures between 80° and 85° F. and a relative humidity of 90 per cent. Effective healing will take place in about ten days when sweetpotatoes are kept under these conditions.

The old idea of curing was that by driving off a lot of moisture the roots were protected from rotting. It is known now that the old, drying-out process was wrong. The newer conception is to keep the roots in a moist atmosphere during curing so as to aid the healing process and to prevent excessive loss of moisture. Only enough ventilation should be given to prevent moisture from forming in drops on the sweetpotatoes or on the walls in the curing house. This conception of the curing of sweetpotatoes is the result of exhaustive experiments by Artschwager and Starrett (1), Lauritzen and Harter (4), and Lauritzen (5).

As soon as the curing period is over (in about ten days) the temperature of the house should be gradually reduced in about two days to around 55° F. If the temperature is lowered too quickly, moisture will condense in the house and rots may start to develop if spores are present. This temperature should be maintained as nearly as practicable throughout the storage period. The relative humidity should be kept as nearly as possible to 85 or 90 per cent. An instrument for determining humidity and costing about $5.00 is helpful but not absolutely necessary. If the house is properly constructed and well insulated, it is not difficult to maintain the desired conditions by manipulation of ventilators and by keeping pans on the floor filled with water when the humidity drops below 75 per cent.

Curing and Store House

Any type of building structure that will allow for ventilation when needed and in which the temperature and humidity can be reasonably well controlled is suitable for use as a sweetpotato storage house. Any house should be provided with some method of heating during curing and during cold periods

Figure 3—Log house built at a low cost and used for seed stock storage by one Mississippi grower. Roots are stored in crates set on poles to raise them off the ground.

in the storage season. Figure 3 illustrates a cheaply built log house, which is very satisfactory as a storage house. Figure 4 shows the detailed plan of a more expensive storage house.

Such houses may be built in various sizes to suit the need, ranging from 100 bushels to 20,000 bushels or more. The plan in figure 4 is for a 1,000 bushel capacity house, and is similar in construction to those larger and smaller. It is practicable in well drained locations to utilize basement or pit storage houses for the storing of sweetpotatoes. **These are entirely satisfactory if they are arranged so that proper heat and ventilation are possible.**

All storage houses or pits must be made rat and mouse proof, because these animals do much damage by gnawing into cured roots, opening to infection fresh wounds after curing. Banking sweetpotatoes should not be depended upon for storage under any circumstances. Crates instead of bins should be used in any storage house. Figure 5 illustrates a very substantial storage crate which with careful handling will last many years. This crate is 12x12x23 inches inside and will hold when filled level 60 pounds of freshly dug sweetpotatoes.

PROPAGATION BEDS

Several kinds of propagating beds may be used, depending upon the needs or size of operations of the grower. When a high total yield is desired, plants must be set early. Early plants can be produced in hot-beds made by any one of several plans. Where sufficient quantities of fresh horse and mule manure are available, a good manure-heated hotbed can be made. Otherwise, various flue-type hotbeds can be made. These may be heated by smoke from wood burning in a fire box at one end being conducted under the bed. Several types of flue beds have been used in Mississippi, and the grower may choose the type best suited to his needs.

Hotbeds may also be built so that heat is supplied by steam or hot water being conducted under the bed through iron pipes. Steam may also be exhausted into 3-inch drain tiles laid underneath the bed. In any kind of bed a cloth cover made of light weight sheeting should be provided. This cover is essential to prevent the cooling effects of spring rains and the rapid loss of moisture by evaporation, and to maintain high humidity in the bed. Sweetpotatoes sprout better at high humidities. Though more expensive, glass sashes conserve more heat and exclude less sunlight than cloth covers.

Single Ditch Flue Hotbed

Figure 6 illustrates a flue bed which is very simple in construction. This bed should be not longer than 50 feet nor wider than 6 feet. To improve drainage from the flue and to help the draft without a tall smoke stack, this bed should be built on a slope with the stack at the higher end. This bed is satisfactory, however, when built on level locations, but a drainage ditch must be provided at the fire-box end and the stack must be about 10 feet high.

As the sketch in figure 6 shows, the flue of this bed consists simply of a ditch 3 feet wide, with the sides cut sloping to prevent caving. This ditch is dug in the center of an excavated area which is the same width as the bed. This excavated area is dug out 18 inches deep at the fire-box end and 6 inches deep at the stack end. Some old pieces of junk iron, such as can be found at any junked automobile dumping ground, should be used to cover 12 to 15 feet of the ditch at the fire end. Poles, slabs, boards or anything convenient that will carry the weight of the soil can be used to cover the remaining part of the ditch. Four 12-inch boards nailed together to form a box makes a good smoke stack and can be easily transported and used

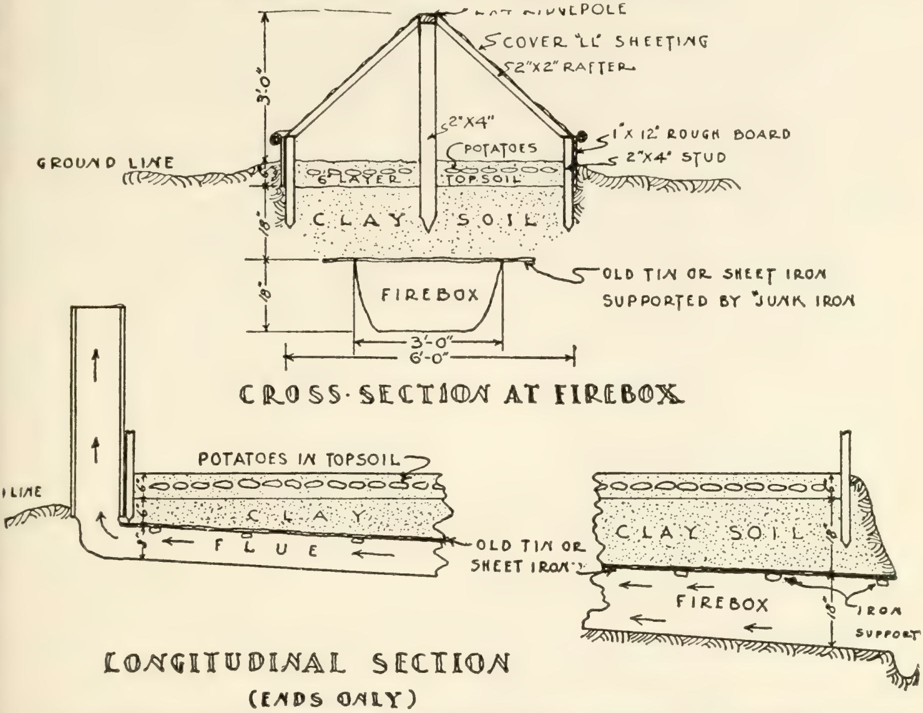

RIDGEPOLE
COVER "LL" SHEETING
2"X2" RAFTER
2"X4"
1"X 12" ROUGH BOARD
2"X4" STUD
POTATOES
GROUND LINE
6" LAYER TOPSOIL
CLAY SOIL
3'-0"
18"
18"
FIREBOX
OLD TIN OR SHEET IRON SUPPORTED BY "JUNK IRON
3'-0"
6'-0"
CROSS-SECTION AT FIREBOX
LINE
POTATOES IN TOPSOIL
CLAY
FLUE
OLD TIN OR SHEET IRON
CLAY SOIL
FIREBOX
IRON SUPPORT
LONGITUDINAL SECTION (ENDS ONLY)

FIGURE 6—SINGLE DITCH FLUE HOTBED

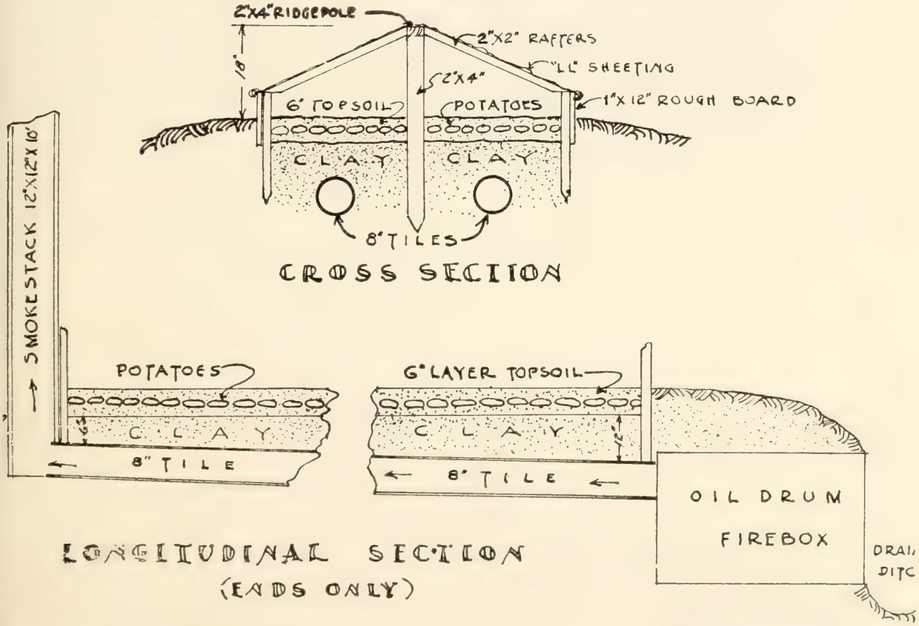

2"X4" RIDGEPOLE
2"X2" RAFTERS
"LL" SHEETING
18"
2"X4"
6" TOPSOIL
POTATOES
1"X 12" ROUGH BOARD
CLAY
CLAY
8" TILES
CROSS SECTION
SMOKESTACK 12"X12"X10'
POTATOES
CLAY
8" TILE
6" LAYER TOPSOIL
CLAY
8" TILE
OIL DRUM FIREBOX
DRAI DITC
LONGITUDINAL SECTION (ENDS ONLY)

FIGURE 7—TILE FLUE HOTBED

from year to year. Clay soil is best for the covering over the flue because it can be tamped until firm and will heat more uniformly than ordinary sandy loam.

In the more temporary type structures the side walls of this bed are made of poles, the bedding medium is of new top soil, and at the end of the season nothing is salvaged for use another year except the cover, stack, and irons at the fire box. The temporary bed is built at a new location the next year or in a location where new or disease-free soil is available.

Tile Flue Hotbed

Figure 7 illustrates a flue bed which is somewhat more permanent in structure but more expensive to build than the bed illustrated in figure 6. In this bed the flues are 8-inch drain tiles. The bed may be wider if more flues are installed. This bed, too, should not be longer than 50 feet. An old 50-gallon oil drum with one end cut out makes a good fire box for this type bed. If a completely permanent structure is desired, the fire box can be built of fire brick and the walls of the bed of concrete or brick. In any event the tiles should be covered with well compacted clay.

Flue Hotbed with Flues above Ground

Figure 8 illustrates a flue bed which has not been used generally by Mississippi growers, but has proven to be a very satisfactory structure where tried. Several of these beds built by the Mississippi Experiment Station and the Sweetpotato Growers Cooperative Association at the Laurel Starch Plant have produced plants satisfactorily. This type bed may be 10 or 12 feet wide, but not longer than 50 feet. Here again it should be emphasized that the soil covering over the hot air space should be well compacted clay. The fire should be 10 feet from the edge of the bed, and the firebox should be 4 x 4 feet. The combustion chamber should be widened toward the bed so that the smoke may enter the air space throughout the width of the bed.

If made of good lumber, concrete or brick, this type bed would last indefinitely with little or no repairs. Made of 2-inch rough cheap lumber (about 1200 boardfeet) it should last for at least three years without repairs. Heat is more uniformly distributed in this type bed than in either the ditch-flue or tile-flue types.

Two-Ditch Flue Type Hotbed

Figure 9 illustrates still another type of flue bed which has been used quite generally by commercial growers in south Mississippi. The bed is similar to the one illustrated by figure 7, differing from it mainly by the sloped ditches instead of tiles serving as flues. This is a less expensive bed than the tile-flue bed, and if made of good lumber it will last for several years. Similar to the bed in figure 7, drainage from the flues and fire box and the draft will be improved if this bed is built on a slope with the fire box located at the lower end. However, if the fire box is lowered by digging down for the oil drum so that its bottom is about two feet below the level of the bottom of the stack, and if care is taken to see that the soil is banked tightly around the bed so that there are no air leaks, sufficient draft will be obtained.

In this bed it is advisable, although not absolutely essential, to arrange for a draft control vent over the combustion chamber as illustrated. It can be partly or completely covered by a small piece of tin, as required to obtain the proper draft through the bed. All of the smoke should go through the flues and should come out of the stack practically cool. If it comes out cool, all of the heat is being absorbed by the bed,

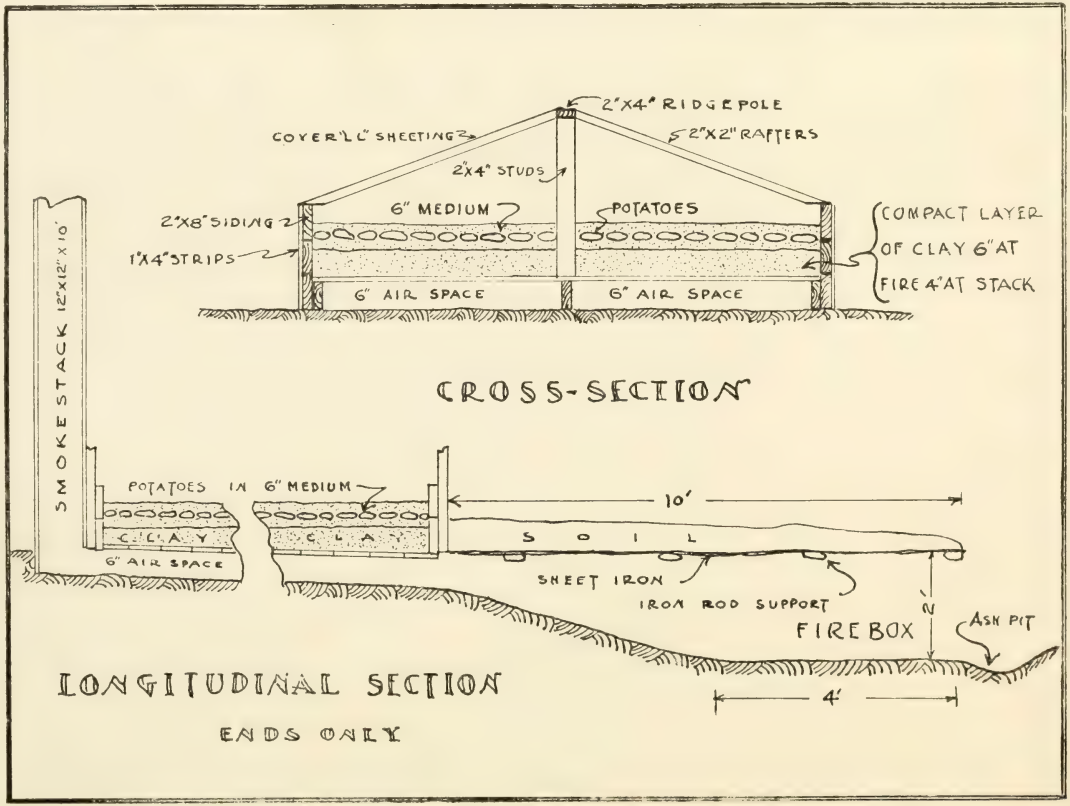

2"X4" RIDGEPOLE
COVER "LL" SHEETING
2"X2" RAFTERS
2"X4" STUDS
6" MEDIUM
POTATOES
2"X8" SIDING
1"X4" STRIPS
COMPACT LAYER OF CLAY 6" AT FIRE 4" AT STACK
6" AIR SPACE
6" AIR SPACE
CROSS-SECTION
SMOKESTACK 12"X12"X10'
POTATOES IN 6" MEDIUM
CLAY
CLAY
6" AIR SPACE
10'
SOIL
SHEET IRON
IRON ROD SUPPORT
2'
FIREBOX
ASH PIT
4'
LONGITUDINAL SECTION
ENDS ONLY

FIGURE 8—FLUE HOTBED WITH FLUES ABOVE GROUND.

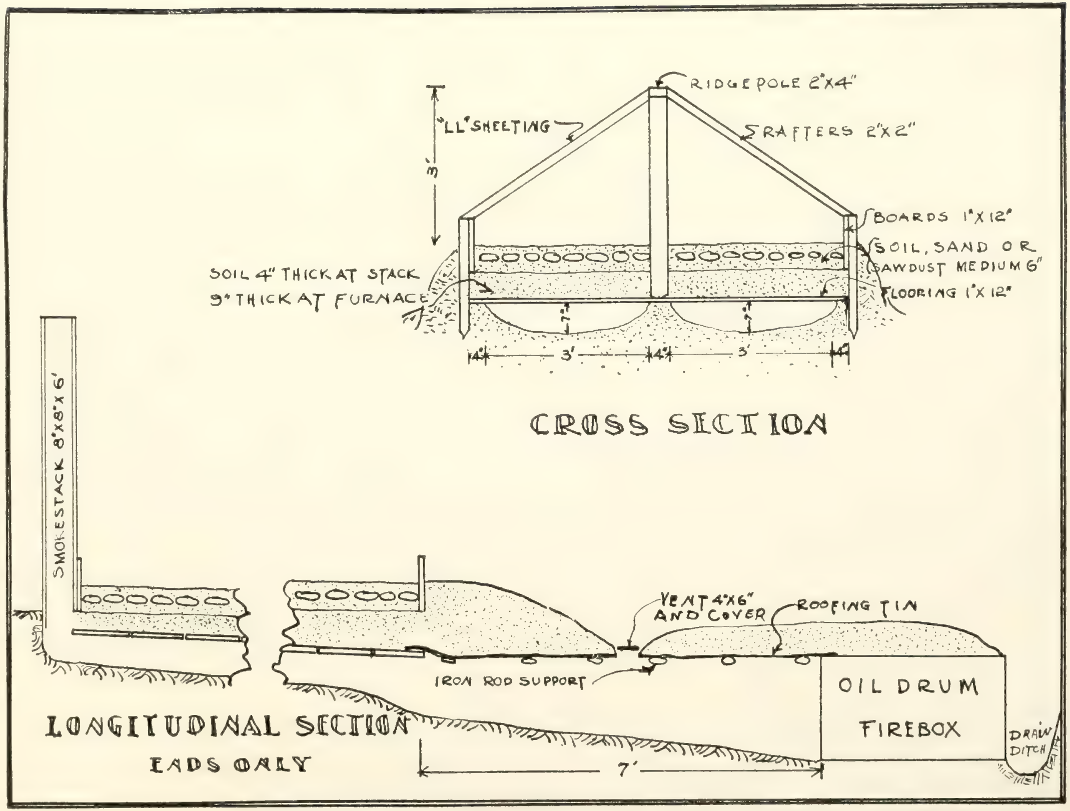

RIDGEPOLE 2"X4"
"LL" SHEETING
RAFTERS 2"X2"
3'
BOARDS 1"X12"
SOIL, SAND OR SAWDUST MEDIUM 6"
FLOORING 1"X12"
SOIL 4" THICK AT STACK
9" THICK AT FURNACE
2'
2'
4"
3'
4"
3'
4"
CROSS SECTION
SMOKESTACK 8"X8"X 6'
VENT 4"X6" AND COVER
ROOFING TIN
IRON ROD SUPPORT
OIL DRUM
FIREBOX
DRAW DITCH
7'
LONGITUDINAL SECTION
ENDS ONLY

FIGURE 9—TWO-DITCH FLUE TYPE HOTBED.

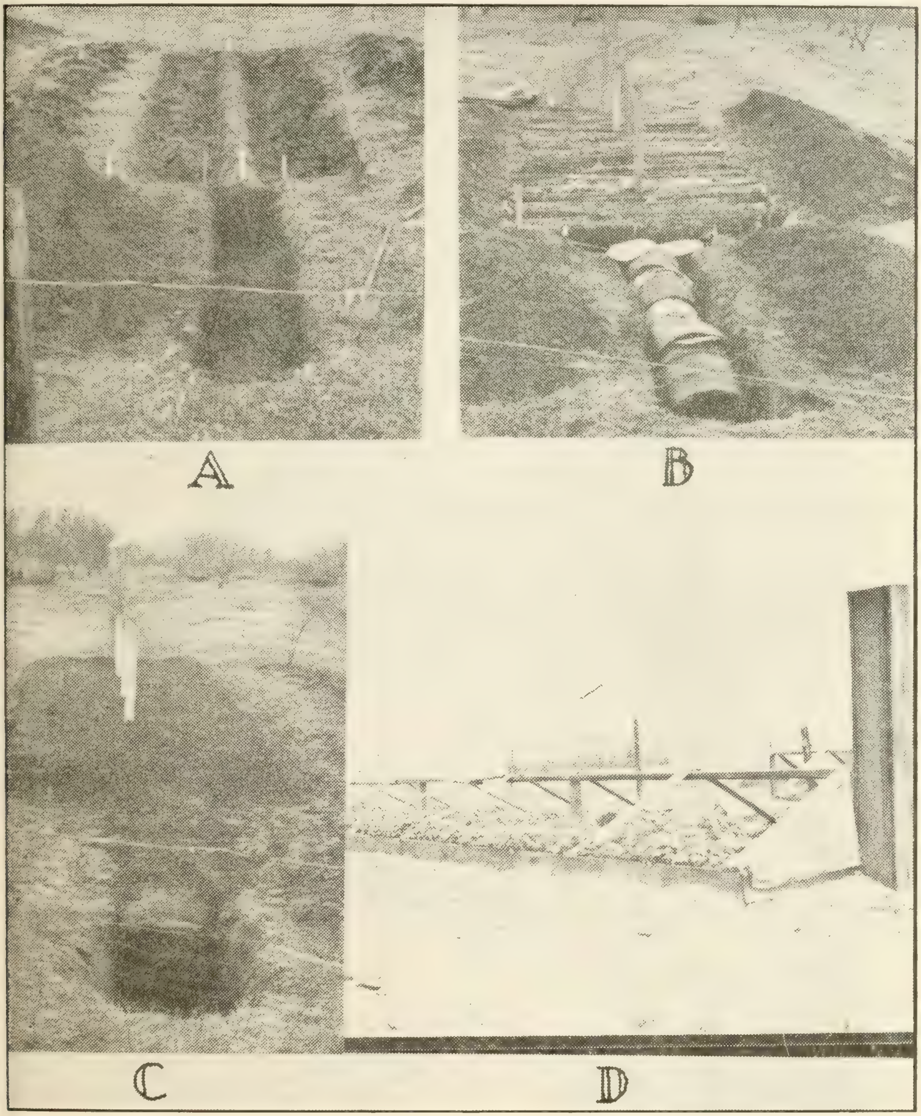


Figure 10—Two-Ditch Flue Bed in various stages of construction:

A. The surface soil has been dug out of the two ditches and the furnace pit completed.

B. The ditches have been completed and covered with poles. The smoke stack has been set up, stakes have been driven in the center to support the ridge pole, and an oil drum with other junk iron has been placed in the furnace pit.

C. The soil has been thrown over the poles and furnace and the bed is ready for the walls of the frame structure.

D. The bed, less cover, during plant growing season.

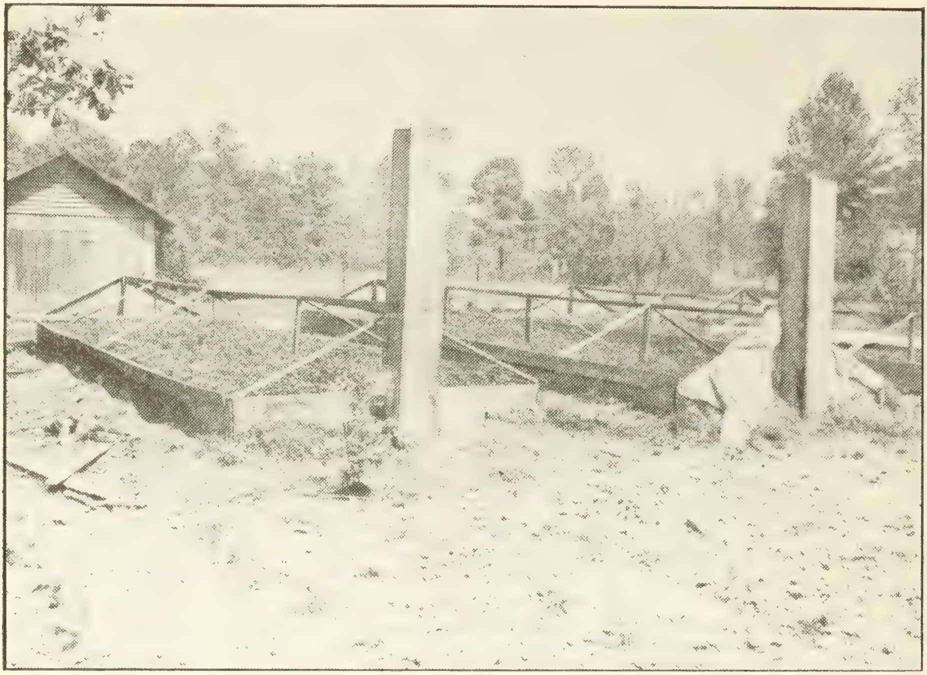


FIGURE 11—TWO-DITCH FLUE BEDS WITH COVERS REMOVED, NOTE EVEN GROWTH OF PLANTS

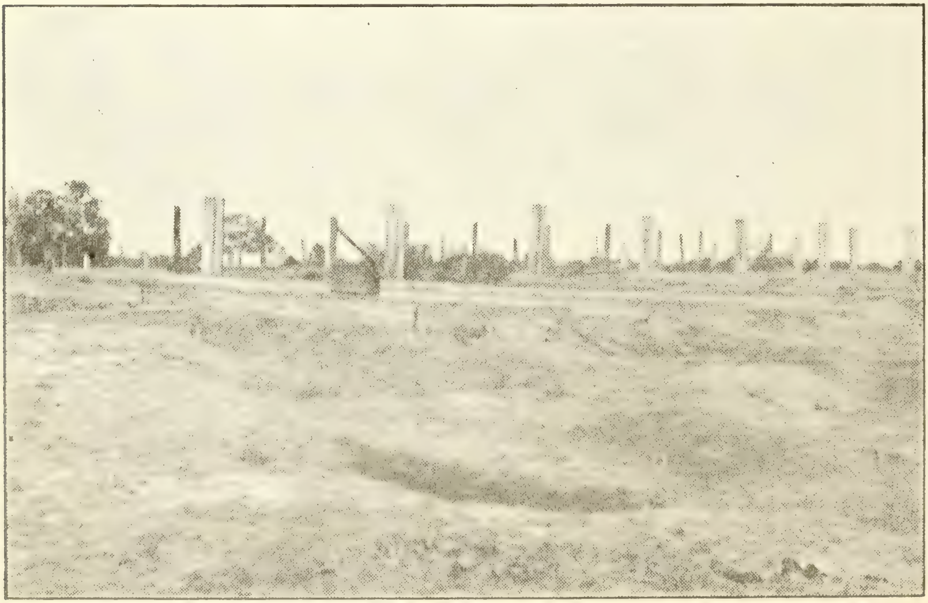


FIGURE 12—PART OF A GROUP OF 24 TWO-DITCH FLUE BEDS, WITHOUT COVERS.

and the maximum benefit is being obtained from the fire.

This bed is usually built 7 feet wide outside measurement. The bedding medium length is 30 feet. Because it provides a very even distribution of heat throughout, this bed is especially good for use in producing very early plants.

Figures 10A, 10B, and 10C show a two-ditch flue bed in various stages of construction and 10D shows the same bed (from the stack end) in the middle of the plant growing season. Unpeeled poles were used with satisfactory results in this bed, and practically no cash outlay was necessary. Figure 11 shows two such beds during the growing season, and figure 12 shows 24 of these without covers.

Electric Heating for Hotbed

Where electric current is cheap enough to be used for heating hotbeds, electric beds may be constructed for sweetpotato plant growing. Detailed plans and instructions for building and operating an electric hotbed are given in Extension Bulletin 106, which can be had by writing the Horticultural Department, Extension Service, State College, Mississippi. Electric hotbeds have a distinct advantage over any other kind in that the heat is automatically controlled, keeping an even temperature at all times.

BEDDING MATERIALS

Soil, sand or sawdust may be used as a bedding material. Some growers find that a mixture of equal parts of sand and sawdust makes a good bedding material.

If sandy loam soil that has not before grown sweetpotatoes or plants is used, clean plants can be produced. Soil requires less fertilizer application than sand or sawdust, and less frequent watering than sand. Sawdust beds hold heat longer than soil or sand beds. However, if no bottom heat is used, sawdust beds warm up very slowly by the heat of the sun on the surface. Sand beds get too hot in the latter part of the season unless partly shaded in the middle of the day, and they cool down more quickly during the night than either soil or sawdust beds. The root systems of plants produced in sawdust are larger than those of plants produced in soil or sand. Soil produces larger root systems than sand. If sawdust is used, the older the better. New sawdust is too coarse for bedding material. Sawdust is more easily transported, is easier handled in the beds, and lends itself more easily to steam sterilization than soil or sand.

Sterilizing the Bedding Medium

Any of these bedding materials can be easily disinfected with chemicals. No bedding material should be used the second time without being sterilized with steam or treated with bluestone (copper sulphate) solution according to the directions of the Mississippi State Plant Board. If disease occurs in an area in the bed after sprouting starts, the sweetpotatoes and bedding material should be removed for several feet around the infected spot and burned. This space should then be disinfected with bluestone (copper sulphate) solution.

Three Bedding Mediums Compared

During 1937 comparison was made by the Mississippi Experiment Station of sand, sawdust and good sandy loam soil as bedding material in a flue-heated cloth-covered hotbed. Plants were pulled at weekly intervals and water was applied only after each pulling. The results are given in table 7 and show very striking differences in favor of

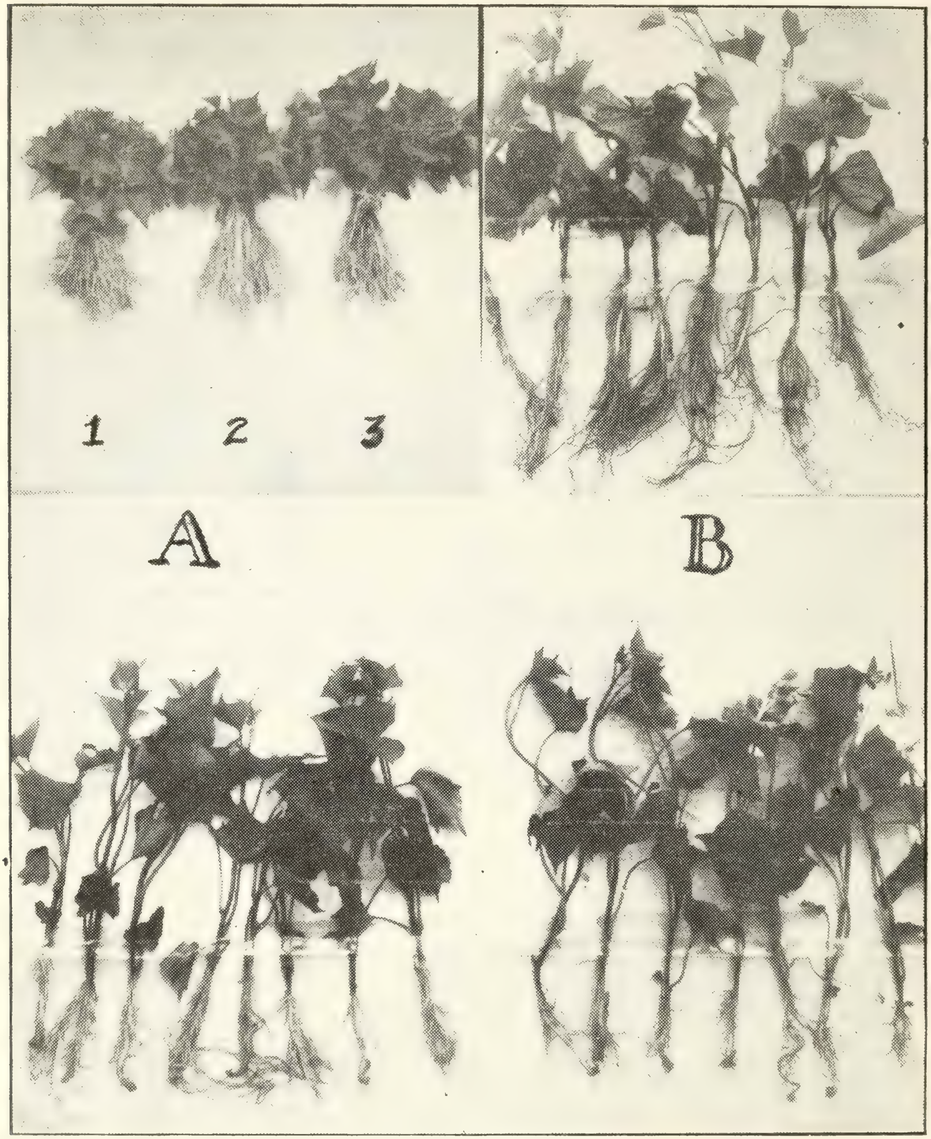


Figure 13—Plants Grown in Various bedding materials.

Upper: A. Bundles of 25 plants, 1937 from 1, sand bed; 2, sawdust bed; 3, soil bed.

Upper: B. Plants from sawdust bed, 1938.

Lower Left: Plants from sand bed, 1938.

Lower Right: Plants from soil bed, 1938.

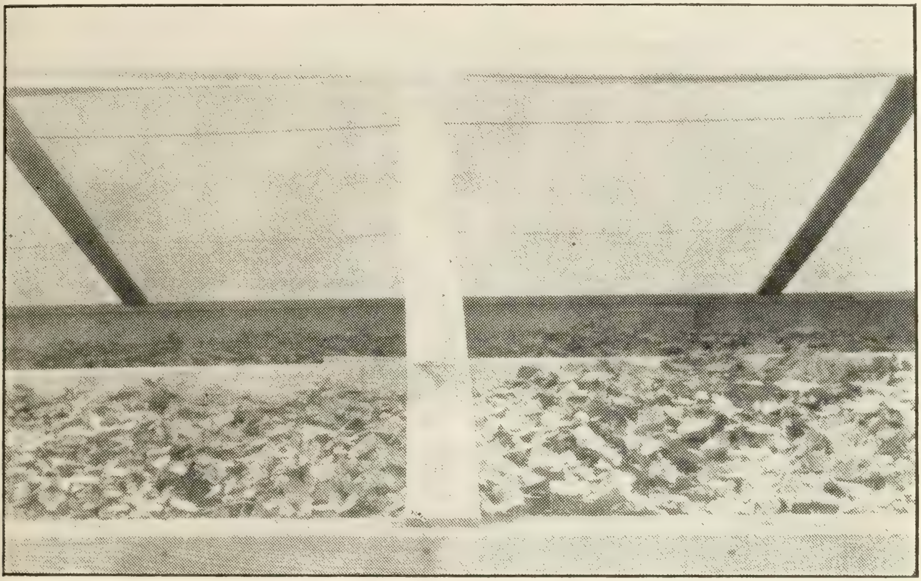


Figure 14—Plants in sawdust hotbed. Left not fertilized, right fertilized after previous pulling

TABLE 7—PRODUCTION OF TRIUMPH SWEETPOTATO PLANTS BY DIFFERENT BEDDING MATERIALS IN A HOTBED, 1937

	Number Plants per 60 lb. bu Seed Bedded			
Material	Early	Midseason	Late	Total
Soil	460	402	565	1427
Sawdust	145	184	223	472
Sand	0	186	304	490

TABLE 8—PRODUCTION OF TRIUMPH SWEETPOTATO PLANTS BY DIFFERENT BEDDING MATERIALS IN A GREENHOUSE BENCH, 1938

	Number Plants per 60 lb. bu Seed Bedded			
Material	Early	Midseason	Late	Total
Soil	634	1142	940	2716
Sawdust	715	1079	1038	2832
Sand	623	1274	1151	3048

TABLE 9—EFFECT OF THE SIZE OF PLANTS ON YIELD OF THE TRIUMPH SWEETPOTATO, AVERAGE OF THREE YEARS' RESULTS

Plot	Plant	Yield per Acre in 60 lb. bu.				
Pair	Size	Jumbo	No. 1	No. 2	Culls	Total
1.	Large	7	297	36	21	343
	Small	10	218	24	23	275
2.	Large	14	245	39	21	319
	Small	13	275	33	17	338
3.	Large	15	304	36	29	284
	Small	16	224	25	16	281
4.	Large	6	291	33	21	251
	Small	22	274	48	24	368
Average	Large	10	279	36	23	324
	Small	15	248	32	20	315

soil under the conditions of the experiment.

In 1938 this experiment was repeated but the sweetpotatoes were bedded in a raised bench in the greenhouse over hot water pipes, each material was watered as often as needed, and pullings were made more frequently than in 1937 or, every 4 to 7 days. The results, given in table 8, show that these bedding materials produce about the same number of plants when given uniform heat continuously and water as needed. Figure 13 shows typical plants from the three materials in the 1937, and the 1938 tests.

It is noted from the tables that the various materials produced many more plants in the 1938 work than in the 1937 work. The lack of agreement between the two years' results can be explained by the difference in the handling of the beds in the two years. In 1938 uniform heat was applied by the hot water pipes, while considerable variation in the temperature occurred in the outdoor hotbed used in 1937. A uniform temperature of about 85° F. day and night is important in good plant production. The way the beds were watered also contributed to the difference between the two years' results.

Each material was watered in 1938 whenever it needed water, but in 1937 no water was applied except after each plant pulling. The mulching and water-holding properties of sawdust helped the plant production of that bed in 1937. Furthermore, nitrogen fertilizer was applied at 2-week intervals during the plant pulling period to the sand and sawdust beds in 1938, but no fertilizer was applied to the beds in 1937. Therefore, it can be said that if sand and sawdust are properly watered and given fertilizer as needed, and used in a bed where the heat is applied uniformly, as good plant production can be expected as from soil.

GROWING AND HANDLING

Seed should be bedded about one month before plants are desired for setting. From 10 to 15 bushels of seed should be bedded for each acre expected to be set from the bed, depending upon the size of the seed and the earliness of setting in the field. A bushel of seed when properly laid so that the roots do not touch, will occupy approximately 10 square feet of bed space; thus, the standard bed 10 x 50 feet will provide space for approximately 50 bushels, or 1 bushel per linear foot. Never bed large and small seed together, as small seed may be covered too deep. When ready to bed, the grower should look carefully through the seed stock and discard any roots that have dark spots or show any signs of disease whatsoever. This precaution may save much trouble later on.

The roots should be dipped for 10 minutes in a solution of 1 ounce of bichloride of mercury dissolved in 8 gallons of water immediately before bedding. Because this material dissolves very slowly in cold water, it should be placed in about 2 gallons of hot water and allowed to completely dissolve. The 2 gallons can then be added to the remainder of the water in a wooden tub or barrel. Use only wooden, glass, or stone vessels for this chemical.

Bedding Seed Stock

The bed should be warmed up to around 85° F. before the seed are placed in the bed. The roots should be covered with 3 inches of bedding medium. Thermometers ought to be placed in the bed so that frequent readings of the temperature can be made and the heat applied accordingly. Use two thermometers, placing one in the coldest and one in the hottest place in the bed. The bed should be kept around 85° F. It is better to keep a slow fire steadily burning than to let the bed cool down

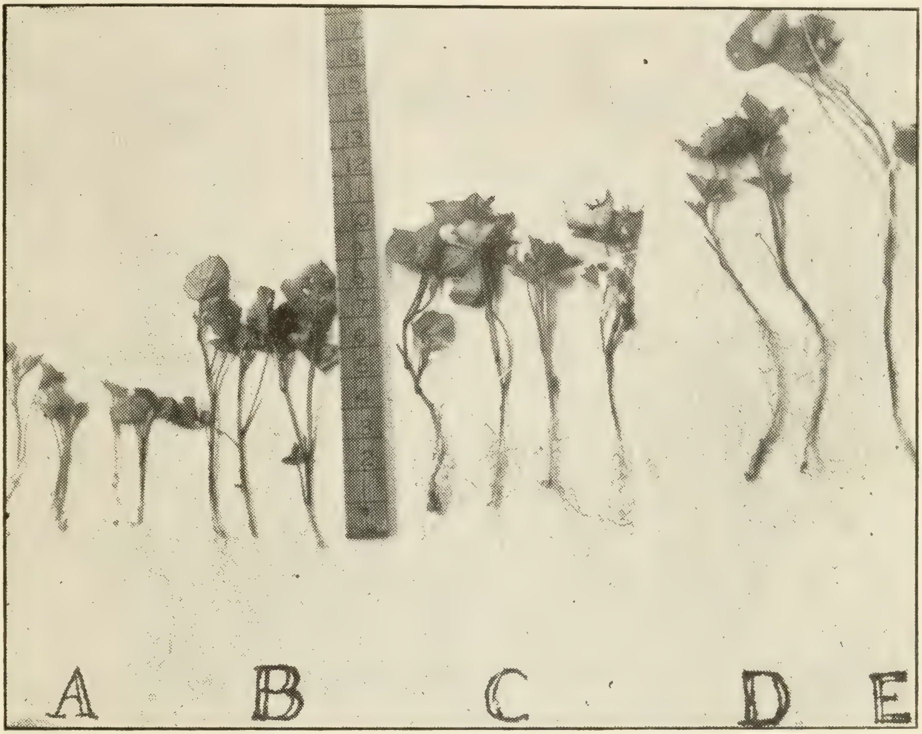


Figure 15—Poor and good plants.
- A. Plants too small for setting.
- B. Plants grown from seed bedded too shallow, causing insufficient root system.
- C. Excellent plants.
- D. Plants having roots too long, because of deep bedding.
- E. Plant too large for setting.

and then try to heat it up quickly with a big fire. Watering should be done as often as is necessary to keep the medium moist around the roots. Usually one good watering per week is sufficient for soil or sawdust beds, but sand will need two or more waterings. The covers should not be opened except during the day time for two days just prior to pulling dates, to allow plants to become hardened to the sun.

Pulling Plants

Large plants are better than small plants because they transplant more successfully and usually yield more potatoes than small plants. See table 9. The first plants usually reach the best size for setting (6 to 9 inches with good root system) in about four weeks from the bedding of the seed, under good sprouting conditions. Successive pullings can be made at 5- to 7-day intervals. Immediately after each pulling the beds should be given an application of a nitrate fertilizer at the rate of 2 pounds per bed 10 feet x 50 feet, watered, and the covers closed. If good soil is used for bedding fertilizing may not be necessary.

Figure 14 shows effects of fertilizer upon a sawdust bed. Figure 15 shows poor and good plants for setting. Very large plants and those having very long root systems are not satisfactorily set with transplanting machines.

Care of Plants

As soon as the plants are pulled, their roots should be immersed in 20-20-50 Bordeaux mixture and then heeled out in damp sawdust in partial shade until they are set or shipped. Experiments by Miles (6) show that this treatment prevents spread of black rot in the heeling-out bed or in the crates during shipment. Roots of plants should never be allowed to dry out, as this results in delayed starting of growth in the field. The plants can be prevented from severe wilting by covering them with wet burlap bags during the interval between pulling and setting in the field.

Attention to these details means the securing of good stands. A good stand is important in making good yields, and good yields are essential to obtaining profits.

Certification of Plants

It is illegal in Mississippi to sell or give away seed sweetpotatoes or sweetpotato plants that have not been inspected and certified by the State Plant Board. Growers who wish to produce certified seed should apply to the Plant Board at State College before June 15 of each year for field inspections. Certified plants can be produced only from certified seed handled according to Plant Board regulations.

Acknowledgments

The author is greatly indebted to Professor F. S. Batson, of the Horticultural Department, for making the drawings for the figures in this paper, and to Mr. John W. Randolph, of the Bureau of Agricultural Chemistry and Engineering, for photographs for figures 10A, 10B, 10C and 12.

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Bulletin No. 350 November, 1940

Home Orchards in Mississippi...

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
MISSISSIPPI STATE COLLEGE
CLARENCE DORMAN, DIRECTOR

STATE COLLEGE, MISSISSIPPI

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Home Orchards In Mississippi

By T. E. ASHLEY, Associate Horticulturist
Mississippi Agricultural Experiment Station

Within recent years practically all the Agricultural agencies of both the State and Federal Government have stressed diversified farming and a live-at-home program. Mississippi has recently made great strides along these lines, yet a very small percentage of the farms have well kept home orchards to supply the home with fresh and canned fruits throughout the year. Therefore the purpose of this bulletin is to aid in the establishment and maintenance of the home orchard.

Perhaps it should be pointed out that research workers are constantly testing new orchard practices, and developing and testing new fruit varieties. On this account present-day recommendations may differ in some respects to recommendations of just a few years ago, and it is to be expected that orchard recommendations of the future may differ in some respects to those of today. Especially is this true regarding varieties. The writer has endeavored to recommend only the latest and best practices, and the recommendations presented in this bulletin are those which have been employed and are now being used in the production of fruits in the Experiment Station orchard at State College.

Successive phases of fruit production discussed in this bulletin include the following: establishing the orchard; training and pruning of fruit trees, grapes and brambles; orchard soil management and fertilization; fruit thinning; insects and diseases and their control; and varieties.

ESTABLISHING THE ORCHARD

Selecting Site

In choosing a site for the home orchard, such factors as soil type and drainage, elevation and slope of land and nearness to the house should be considered. Too often the home orchard has been located on the poorest soil on the farm, resulting in many instances in a complete failure of the plants to produce enough fruit for home consumption.

Most fruit plants will adjust themselves to a wide range of soil types. In general the peaches, plums, grapes, strawberries, and brambles do best on the lighter loam types, while the apples and pears thrive best on the heavier loam soils. The soil should provide for an extensive root range, be well drained, reasonably fertile, of good texture, and contain an appreciable amount of organic matter. Any soil that produces good crops of corn or cotton should be suitable for fruit production.

Since the cold air settles to the lower levels, the elevation of the land should be such as to provide for a continuous movement of air through and away from the planting, to reduce to a minimum the hazard of frost injury to the blossoms. Furthermore, fungous diseases are more prevalent in low areas where the foliage of the plant dries off slowly and the air is still.

The orchard should be conveniently located near the house, protected from livestock, and should fit in with the general landscape program of the farmstead.

Obtaining Nursery Stock

It is false economy to purchase cheap nursery stock for the orchard. Those plants sold at bargain prices are usually of inferior grade and in most instances are not vigorous and do not attain the size they should, even with the best of care. The best plants in any given age group should be purchased. This does not necessarily mean that they must be expensive, as many nurseries have very good plants available at reasonable prices.

In most instances nursery stock of tree fruits is sold as one-year-olds and two-year-olds. An exception to this is the peach, which is also sold as June Buds (those budded in May or June and transplanted the following dormant season). In each age group there are three size groups: large, medium and small. Grapes and brambles are usually sold according to age only; that is, one year or two years of age. Since one-year-old plants withstand the shock of transplanting better than the two-year-olds, they are recommended for the orchard. In any instance nothing less than the medium size in any particular age group should be used.

If for any reason it is impossible to set the plants immediately after arrival from the nursery they should be heeled in by plowing out a deep furrow and placing them in a sloping position against the furrow side of the trench and covering the roots with moist soil, as illustrated in figure 1.

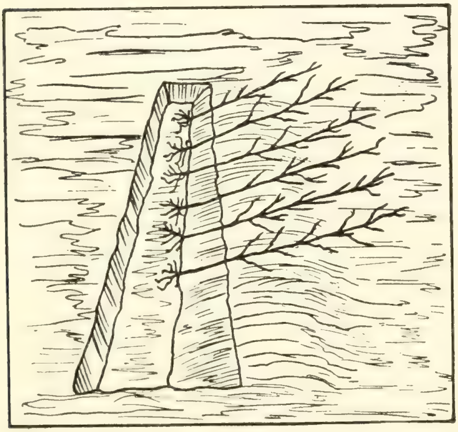


FIGURE 1—If there is to be a delay in planting, the fruit plants should be heeled in immediately after arrival from the nursery by either digging or plowing a furrow and covering the roots with moist soil.

It is very important that the soil be well prepared before setting the plants, since it will be practically impossible to break the land after they are set out. Unless a tilled crop was grown the previous year on the land selected for the orchard, it should be well broken in the early fall before setting the plants. This will permit the ground to settle and an abundant supply of moisture to be absorbed. Immediately before setting the plants the land should be disced and harrowed until it is friable and in good physical condition.

Laying Out the Orchard

The system used to lay out the orchard will be determined largely by the topography of the land. On rolling land, of 2 per cent and more slope, terraces should first be constructed. The tree rows should then be laid off parallel to the terraces much in the same manner as with annual crops, with no effort being made to keep the trees aligned up and down the slope. Whether or not the trees are set on the terrace proper is more or less an individual preference. It should be pointed out, however, that some provision should be made to keep the terraces maintained. If the land does not need terracing, either the square or triangular system should be used. Figure 2 illustrates the square, triangular and contour systems of planting.

In the square system the trees are equal distance apart and at right angles to each other To establish this system erect base line A-B (see figure 3) on one side of the plot of ground, placing stakes at positions where the trees are to be set. Place stake C on base line A-B, 40 feet from point A.

From point A measure 30 feet at an approximate right angle to line A-B and set stake D. Change position of stake D without altering other measurements until line C-D is exactly 50 feet. On line A-D place stakes where the trees are to be set. The positions of the other trees are found by using the planting wire. Place rings X and Z over the first stake of each of the base lines and pull ring Y until the wires are equally tight. This will locate the position of the second tree on the second row. Continue this process until the orchard is laid out.

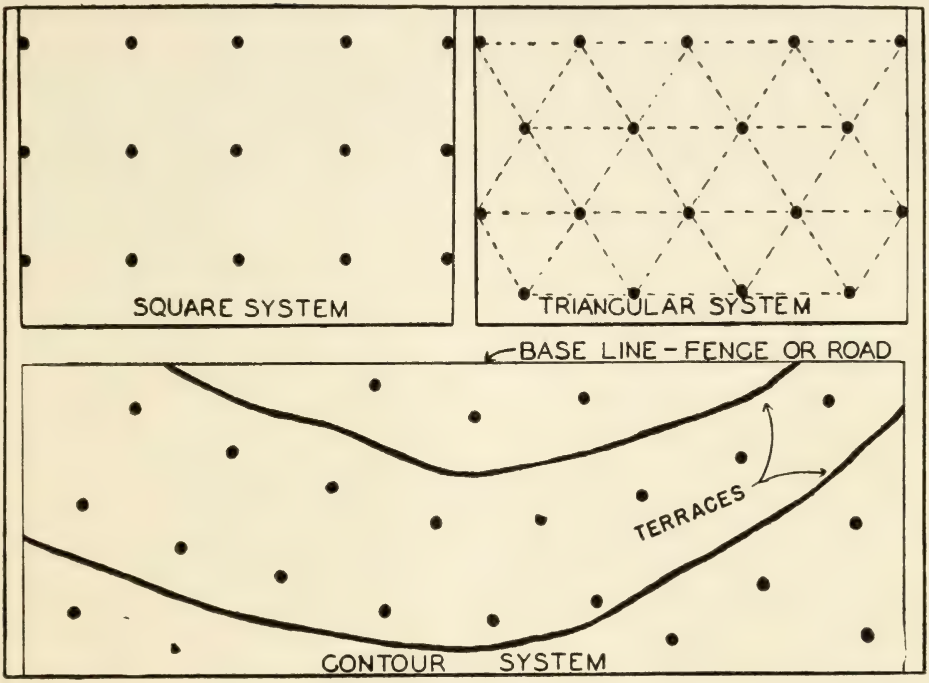

SQUARE SYSTEM
TRIANGULAR SYSTEM
BASE LINE - FENCE OR ROAD
TERRACES
CONTOUR SYSTEM

FIGURE 2—Illustrating the square, triangular and contour systems of planting.

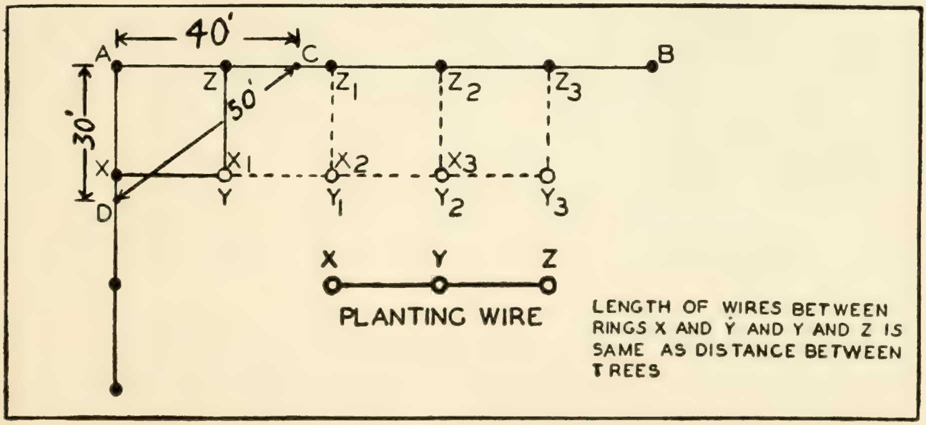

40'
A
C
B
Z
Z_1
Z_2
Z_3
50'
30'
X
X1
X2
X3
Y
Y_1
Y_2
Y_3
D
X
Y
Z
PLANTING WIRE
LENGTH OF WIRES BETWEEN RINGS X AND Y AND Y AND Z IS SAME AS DISTANCE BETWEEN TREES

FIGURE 3—Illustrating in detail the laying out of an orchard according to the square system. After the base lines have been established, place rings X and Z of the planting wire over the first stake of each of the base lines and pull ring Y until the wires are equally tight. This will locate the position of the second tree of the second row. Continue this process until the orchard is laid out.

In the triangular system the trees are equal distance apart and from equilateral triangles. To establish this system, erect base line A-B as shown in figure 4 and place stakes at positions where the plants are to be set. With the planting wire place rings X and Z over the first and second stakes of the base line. Pull ring Y until wires are equally tight and place stake at Y. This will locate the position of the first tree on the second row. Continue this process until the orchard is laid out. When this system is used about 15 per cent more trees may be set on a given piece of land than when the square system is used.

Setting The Plants

If conditions are favorable the plants should be set during early winter, probably December. At this time the plants are completely dormant, and if set then the roots will have ample time to become established in the soil before growth starts in the spring.

The holes made for setting the plants should be large enough to receive the roots without bending them from their natural positions, and deep enough so that the plants may be set from one inch to two inches deeper than they stood in the nursery row. Before the plants are set, all broken and bruised roots should be removed and any long slender roots may be cut back to a normal length.

The planting board illustrated in figure 5 may be used to keep the plants in direct alignment. Place the center notch over the stake where the tree is to be planted and place two other stakes at the end notches of the board. Remove the board and center stake, dig hole, and place the board back in position between the two stakes and set the tree at the center notch.

The soil should be worked in and tamped firmly about the roots of the tree as shown in figure 6. This is probably the most important single factor in setting the plants, for if the soil is well tamped it reduces to a minimum the air spaces in the soil. Fertilizer should not be mixed with the soil while setting the plant.

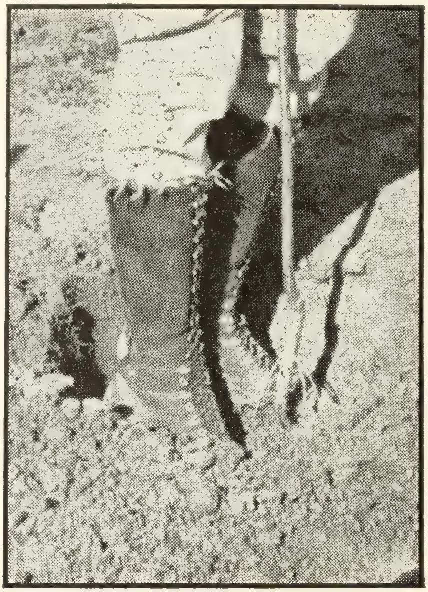


FIGURE 6—The soil should be well tamped about the roots of the tree. Do not mix fertilizer with the soil.

Planting Distances

Such factors as varieties, growth habits, pruning practices, soil fertility and moisture content of the soil will determine largely the distance to set the plants. Plants which are lightly pruned and grown on good soil with an ample supply of moisture will grow much larger and require more space than those which are heavily pruned and grown on poor soil with a low moisture content. Table 1 lists the fruits, recommended planting distances and number of plants required per acre for the common fruits.

TRAINING AND PRUNING

Training may be defined as the removal of plant parts to influence the shape or form of the plant; while pruning is defined as the removal of plant

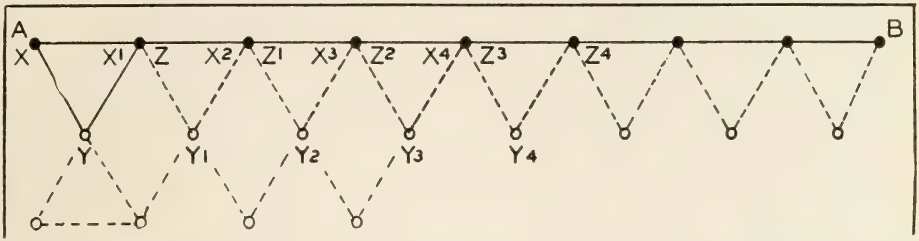


FIGURE 4—Laying out the orchard by the triangular system. After base line A-B has been established place rings X and Z of the planting wire over the first and second stakes and pull ring Y until the wires are tight. This will locate the position of the first tree of the second row. Continue this process until the orchard is laid out.

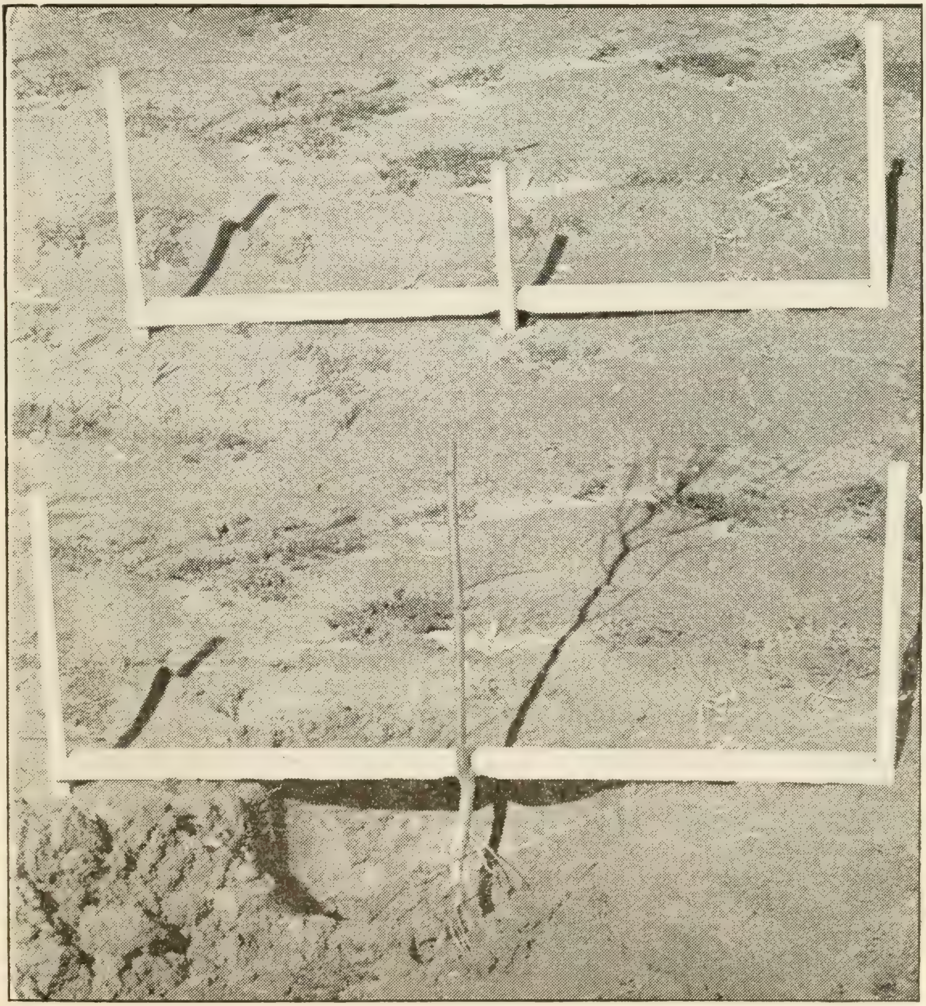


FIGURE 5—By the use of the planting board the tree may be set in the same position as was the stake, thereby keeping the trees in direct alignment.

TABLE 1—RECOMMENDED PLANTING DISTANCES AND NUMBER OF PLANTS REQUIRED PER ACRE OF THE COMMON FRUITS

Fruit	Recommended Planting Distances	No. Plants Required Per Acre (Based On Square System)
Pecans	60' X 60' to 80' X 80'	12 to 7
Pome Fruits		
Apple	30' X 30' to 35' X 35'	48 to 36
Pear	25' X 25' to 30' X 30'	69 to 48
Stone Fruits		
Peach	20' X 20' to 25' X 25'	108 to 69
Plum	20' X 20' to 22' X 22'	108 to 90
Cherry	20' X 20' to 22' X 22'	108 to 90
Figs	20' X 20' to 22' X 22'	108 to 90
Jap. Persimmons	20' X 20' to 22' X 22'	108 to 90
Grapes		
Bunch	8' X 8' to 10' X 10'	680 to 435
Muscadines	Rows 10' apart, Plants 15'-20' in row	290 to 218
Brambles		
Dewberry type	8' X 8' to 10' X 10'	680 to 435
Blackberry type	Rows 10' apart, Plants 3'-4' in row	1452 to 1089
Strawberries	Row 3½' apart, Plants 18-24" in row	8297 to 6223

parts to influence the function of the plant; that is, fruit production. In general, most of the training is done while the plant is young, to cause it to develop a definite form or shape. Pruning is done after the plant comes into bearing to encourage or promote fruit production.

Training the Tree Fruits

One of two systems of training is generally used with the tree fruits. These are the **modified leader system** and the **open center system**, and are shown in figure 7. A tree trained to the modified leader system is usually stronger than one trained to the open center. The modified leader is recommended because it more nearly approaches the natural growth habit of the tree. In this system the scaffold limbs (main branches) are spaced six to eight inches apart vertically on the trunk of the year-old tree, while in the open center system all the scaffolds arise at about the same point, often resulting in weak crotches allowing the limbs to split off when they are heavily loaded with fruit or during a wind, as shown in figure 8.

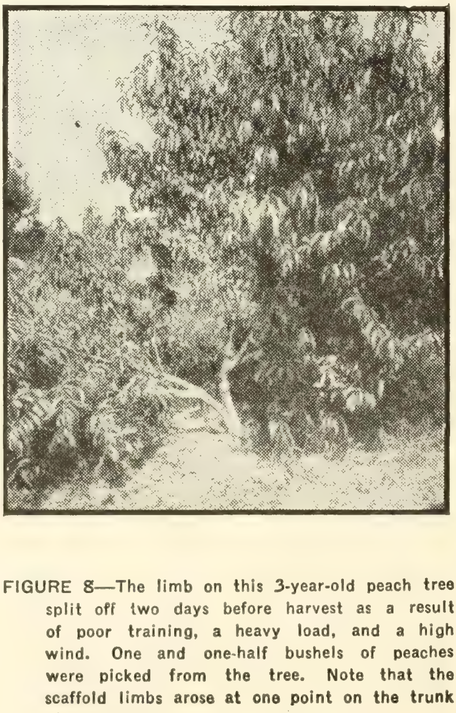


FIGURE 8—The limb on this 3-year-old peach tree split off two days before harvest as a result of poor training, a heavy load, and a high wind. One and one-half bushels of peaches were picked from the tree. Note that the scaffold limbs arose at one point on the trunk of the tree.

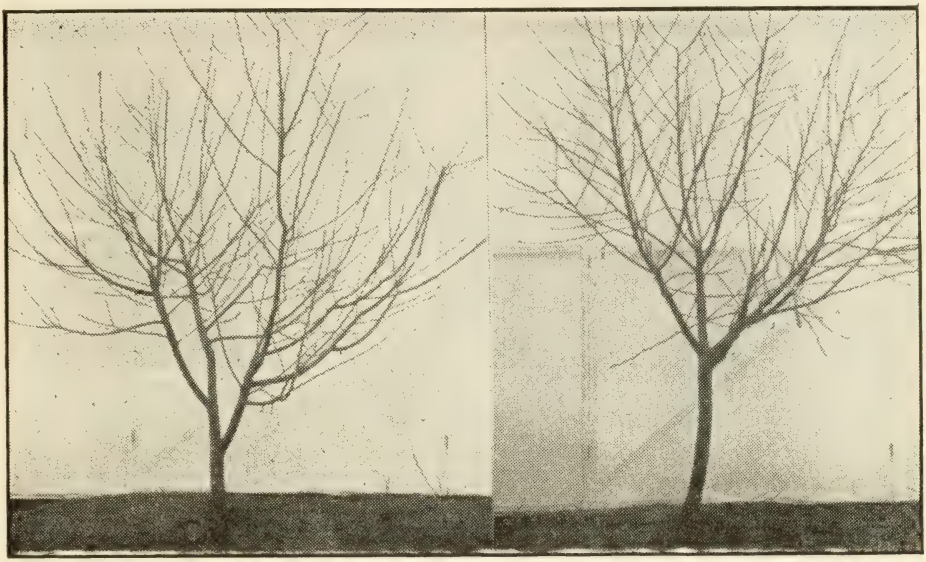


FIGURE 7—(Left) A two-year-old peach tree trained to the modified leader system (note that the scaffold limbs are spaced six to eight inches apart). (Right) A two-year-old peach tree trained to the open center system. All the scaffold limbs arise from the same point on the trunk of the tree.

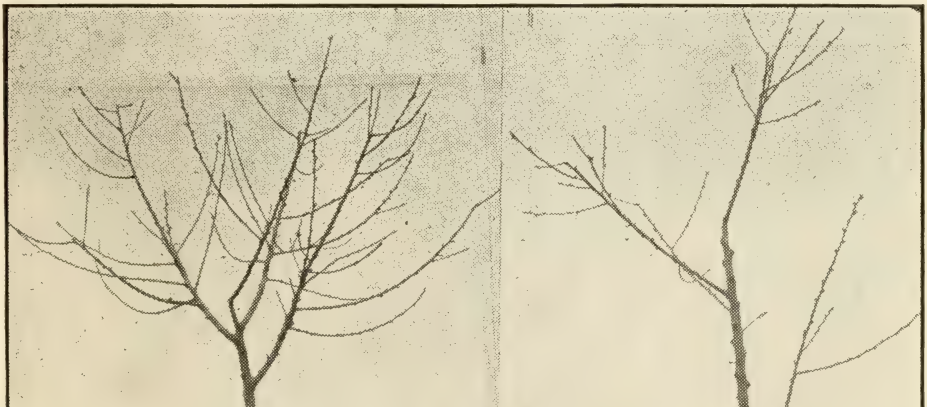


FIGURE 9—(Left) A one-year-old peach tree after summer training was practiced. Note that the scaffold limbs are well developed and balanced. (Right) A one-year-old peach tree that has received dormant training.

Summer Training

Within recent years summer training of fruit trees has received considerable attention from research workers. Summer trained trees have an advantage over dormant trained trees in that a larger tree may be produced in a shorter length of time. It is not uncommon with the peach for a three-year-old summer trained tree to attain the size of a four-year-old dormant trained tree, because with summer training all the excess branches are removed when quite small and the entire growth of the tree goes into the development of the scaffold branches that have been selected, while with dormant training most of the first year's growth must be removed and is therefore largely wasted. Figure 9 shows one-year-old peach trees that have been summer and dormant trained.

Training Peach Trees

The Modified Leader System

In training a peach tree to this system the tree should be cut back to about 32 to 36 inches at planting time and all lateral branches cut back to two buds. After the new growth has reached a length of from four to six inches, select from three to five well distributed scaffold branches, spaced six to eight inches apart vertically, as shown in figure 10. About 10 days to two weeks after the scaffold limbs have been selected, it will be necessary to go over the trees again and remove any superfluous shoots that have arisen since the selection of the scaffolds. When the scaffold limbs have reached a length of from 20 to 22 inches the terminal buds should be removed to encourage the formation of secondary scaffolds. By the end of the first growing season the primary shoots and a greater part of the secondary shoots should be formed.

Dormant training the first year should consist of a very light thinning of the secondary scaffolds, and some heading of the main branches to outside lateral branches or buds. The smaller inside branches of the primary scaffolds should not be removed as they will serve to shade the trunk of the tree, and also a great many of them will develop into fruiting shoots which will produce fruit the third year.

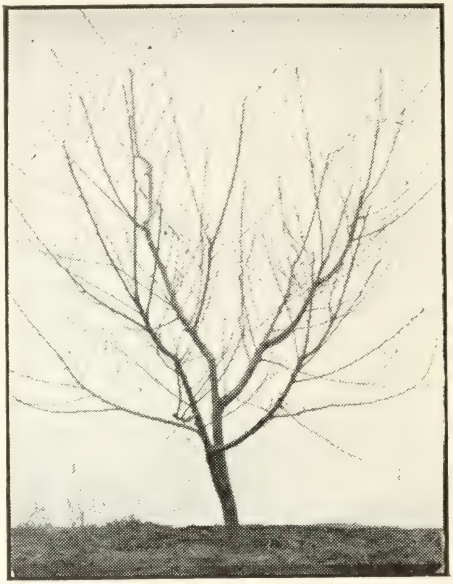


FIGURE 11—A two-year-old peach tree which was summer trained showing the necessary pruning which was done during the second dormant season. Note that the upright growing branches were cut back to shoots growing in an outward direction.

Throughout the second growing season very little training will be necessary. The secondary scaffolds will continue to develop in length and will produce quite a few lateral branches, which will bear fruit the third season. By the end of the second growing season, the frame work of the tree should be practically completed. It will be necessary to thin the trees where the branches are crowded and head the main limbs back lightly to outside buds or lateral shoots, as illustrated in figure 11.

The Open Center System

The same procedure is followed in training the peach to the open center system as in the modified leader system except that the trees are cut back at planting time to 18 to 24 inches, resulting in the scaffold limbs arising from practically the same point on the trunk of

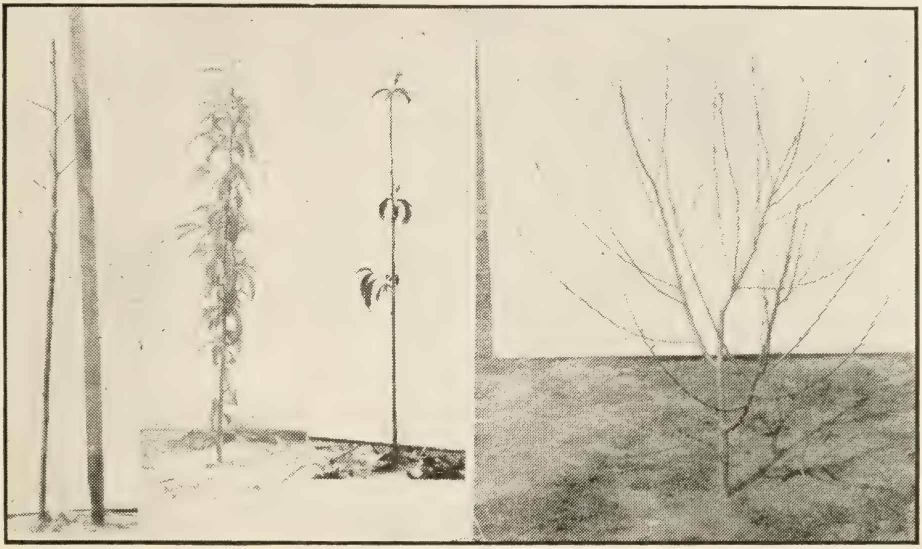


FIGURE 10—Showing the steps (from left to right) to follow in summer training a peach tree to the modified leader system from the time of setting the tree through the first dormant season. Three to five scaffold limbs should be selected in order to give a well balanced tree.

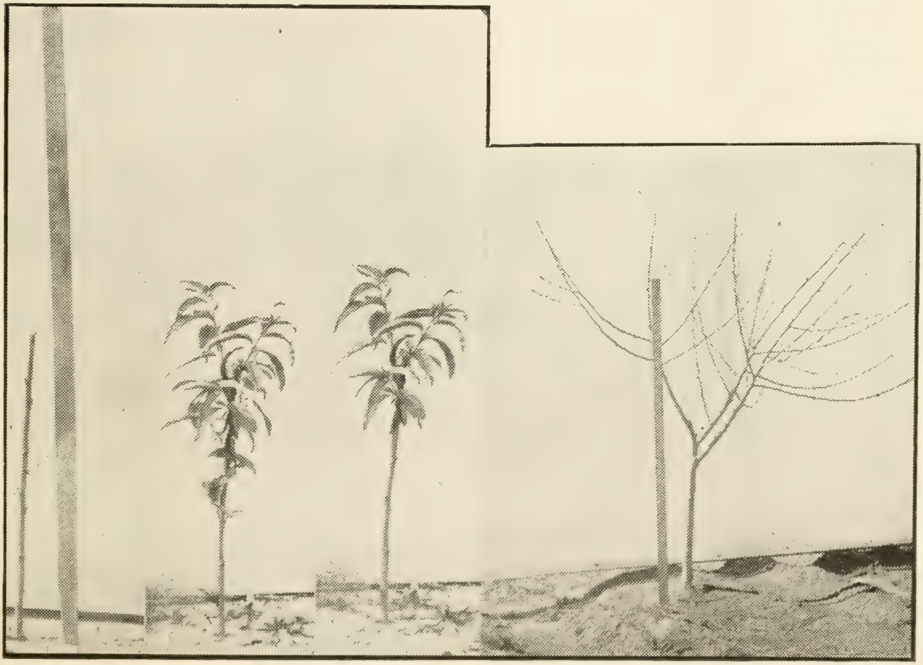
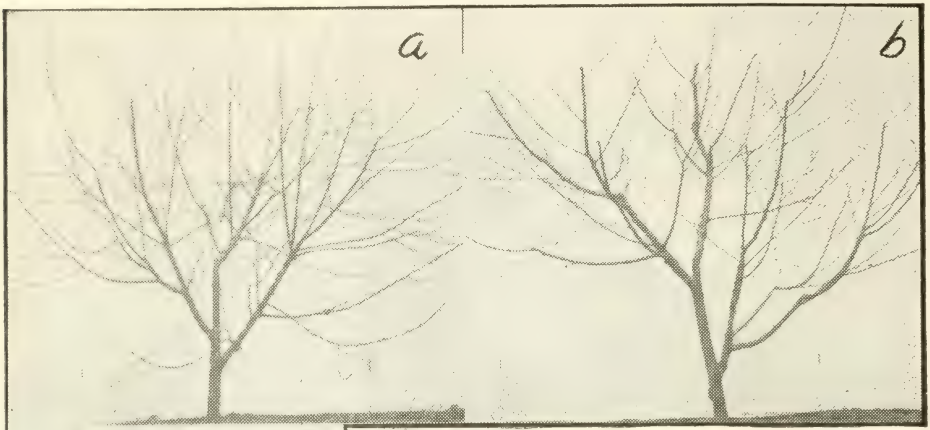


FIGURE 12—Illustrating the steps to follow in summer training a peach tree to the open center system from the time of setting the plant through the first dormant season.



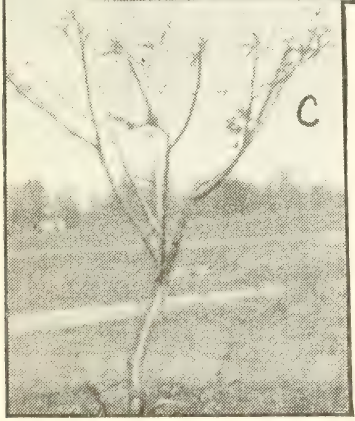


FIGURE 14—Showing the effects of pruning on two-year-old peach trees. (a) Light pruning, which should be practiced, (b) Medium heavy pruning and (c) Heavy pruning. Very little fruit will be produced on the tree receiving the medium heavy pruning and none on the tree which was heavily pruned, while the tree receiving the light pruning will produce a good crop of fruit.

the tree. Figure 12 illustrates the steps to follow.

Training Other Tree Fruits

With few exceptions, the same general principles of training as outlined for peaches should be followed for the other common deciduous (those that shed their leaves during the dormant season) tree fruits. In the case of the apples and

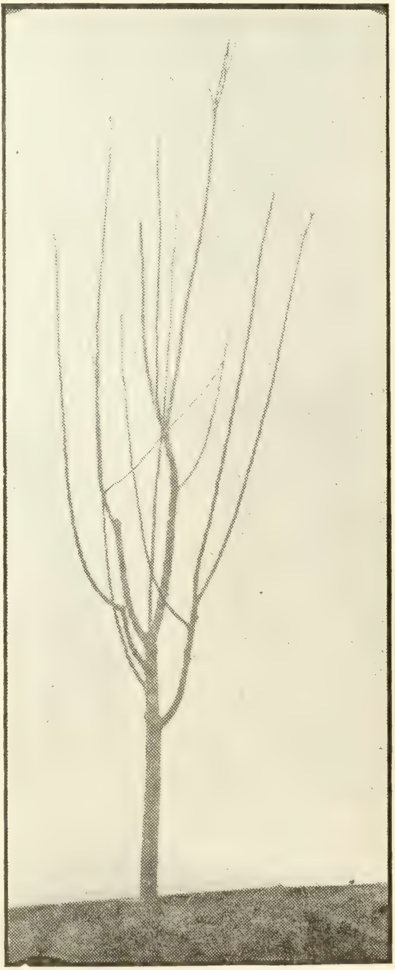


FIGURE 13—A two-year-old apple tree trained to the modified leader system. Note that five to eight scaffolds are selected rather than three to five as with peaches.

pears, five to eight scaffold limbs as shown in figure 13 should be selected instead of three to five as with peaches. This will necessitate cutting the tree back to 42 to 48 inches at planting time rather than 32 inches. Plums should receive the same treatment as peaches. Figs are usually grown to the bush form, thereby requiring no special attention as to training.

Pruning the Tree Fruits

Recent investigations have shown that larger trees and larger crops of fruit are secured from much lighter pruning of trees than that formerly practiced. (See figure 14.) Pruning is a dwarfing process and therefore reduces the fruiting area and shortens the life of the tree. While the tree is young and capable of producing large crops of fruit the pruning should consist of a light thinning out of the branches, removing crossing and crowding shoots to permit uniform light distribution throughout the tree, and a light heading back of the larger branches to outside laterals to prevent the tree from becoming too tall, as shown in figure 15. As the tree becomes older the amount of pruning must be increased to stimulate the production of new shoots so that an adequate amount of fruiting wood will be present, and to maintain the desired height and width of the tree which will permit the most economical operation of the necessary orchard practices. This may be accomplished by a moderate thinning out of branches and by cutting back occasionally into the older wood, always cutting to an outside lateral branch.

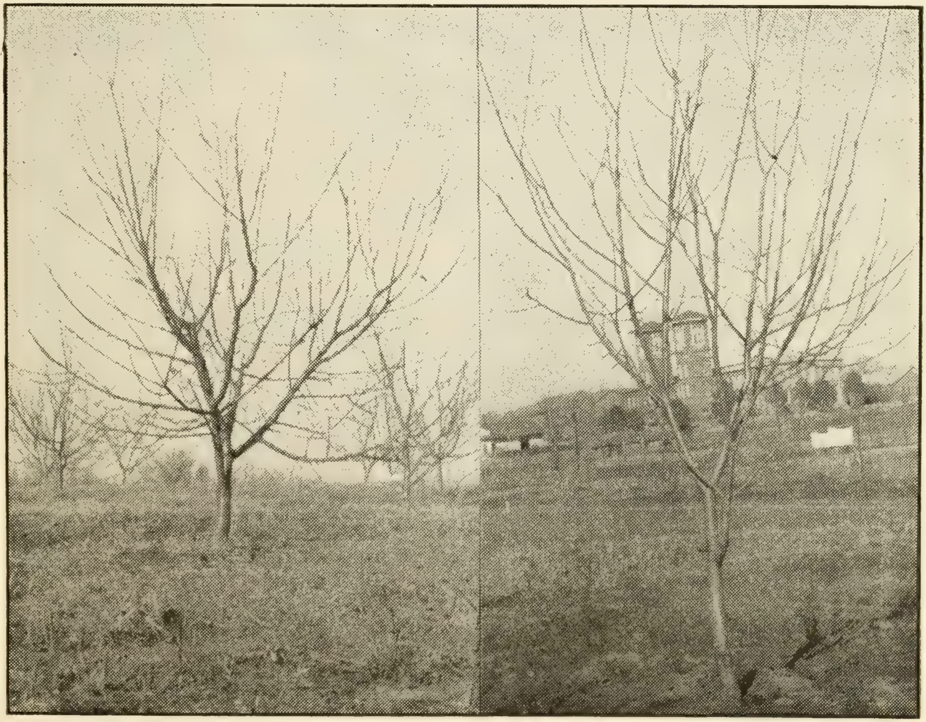


FIGURE 15—(Left) A four-year-old peach tree and (right) A five-year-old apple tree both of which have received light pruning. Note that the branches have been cut back lightly each year to outside lateral branches.

Thinning and Heading

Thinning consists of the removal of an entire shoot, while heading consists of the removal of only a portion of a shoot. In the deciduous tree fruits most of the stored food is in the terminal portions of the shoot. Therefore, thinning equally severe (in weight or length) removes less stored food and is less devitalizing on the plant than is heading. Thinned trees make normal growth, store up food normally and produce numerous fruit buds and spurs, whereas, headed trees tend to grow late in the season, have bushy tops and produce fewer fruit buds and fruit spurs. Heading disturbs the equilibrium in the tree, changing its tendency from fruitfulness to vegetativeness, and should not be practiced except in training trees or to keep them in bounds.

Season of Pruning—In general all pruning should be done during the dormant season. Summer pruning may be done to an advantage in training young trees and to remove water sprouts to conserve moisture and nutrients.

Renewal Pruning—Many fruit trees, especially peaches, become devitalized through neglect. Such peach trees have scaffold limbs 15 to 20 feet long and normally produce shoots of from one to three inches in length in the extreme top and outside of the tree, with an extensive area in the center of the tree producing no fruit. In many cases, trees of this type may be made productive again by heading the scaffold limbs back during the dormant season to a length of six

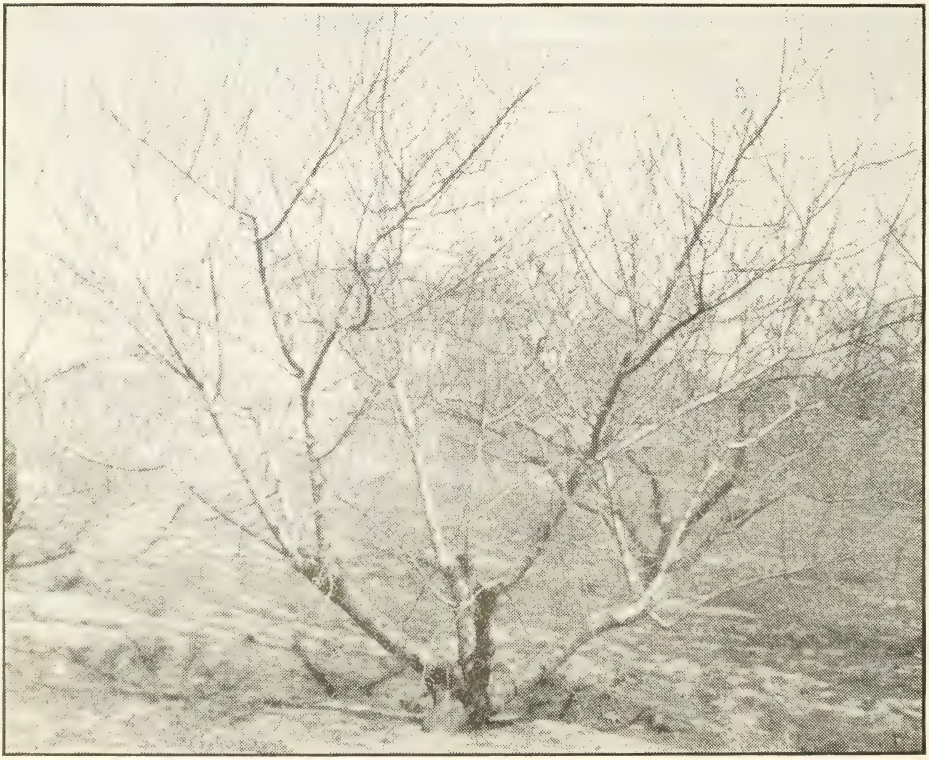


FIGURE 16—A 17-year-old Hiley peach tree five years after de-horning was done. Note that the secondary frame work has been completely rebuilt.

to eight feet and the remaining lateral limbs to a length of two to three feet. An abundance of new shoots with a good supply of fruit buds will be produced from these cut back limbs. During the following dormant season the pruning should consist of a moderate thinning out of the new shoots and the stronger shoots headed back to outside lateral branches. Thereafter, light pruning should be followed.

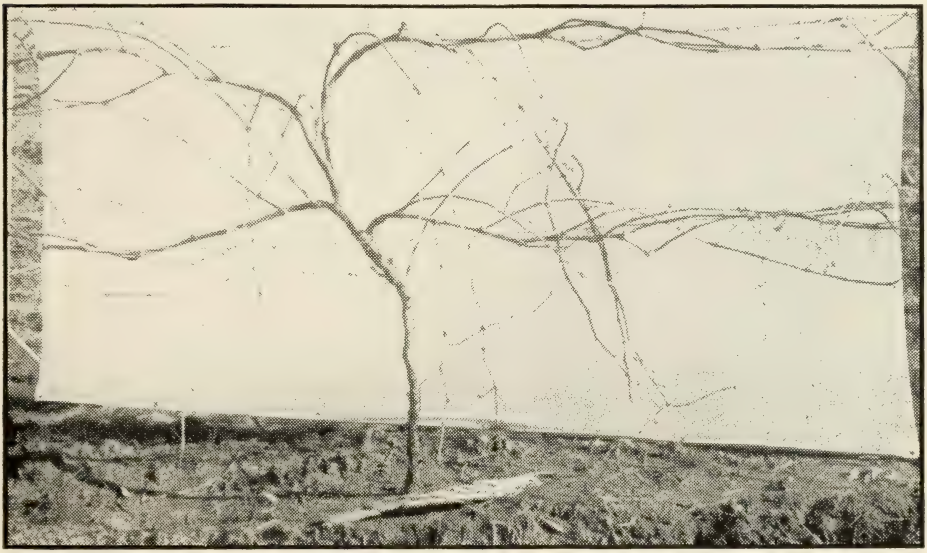


FIGURE 17—A grape plant trained to the four-cane Kniffin system (before pruning).

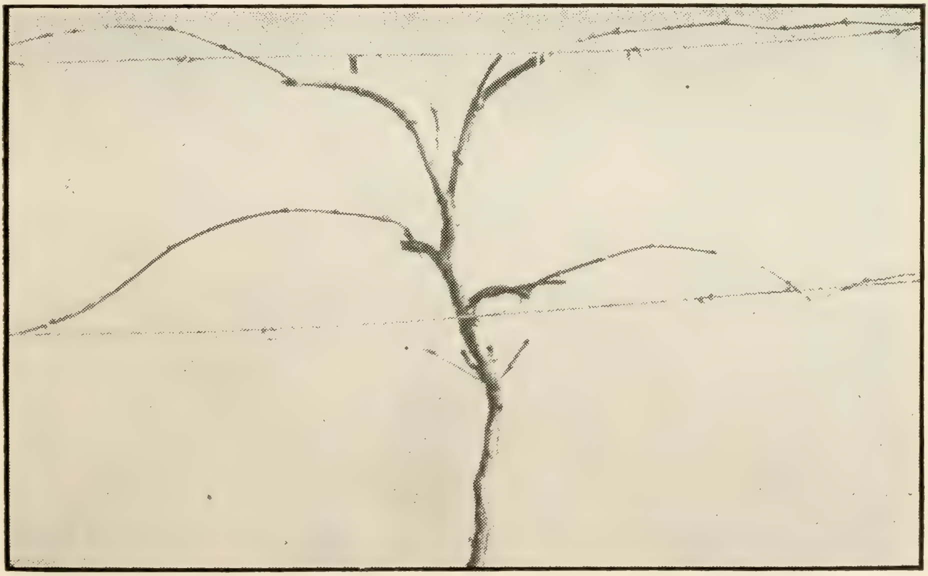


FIGURE 18—The same grape plant as figure 17, after pruning.

Figure 16 illustrates a 17-year old Hiley peach tree five years after renewal pruning was done.

GRAPE TRAINING AND PRUNING

Both training and pruning of grapes are usually thought of as pruning, but because there are a number of training systems the two should be distinguished. Training has to do with the establishment of the body of the vine to insure a good distribution of its parts to facilitate such operations as spraying, cultivation, pruning and harvesting. Pruning is concerned with production, and controls total yield and the size and quality of the fruit of the plant.

Grapes should be pruned during the dormant season, with December probably being the best month, since the plants are usually completely dormant at this time and less bleeding is likely to occur.

Bunch Grapes

Any one of several systems of training bunch grapes may be used. Since the four-cane Kniffin system is easy to establish, and provides ample support for the plants, it is described here. To establish this system set posts at 20-foot intervals on the row letting them extend at least four feet above the ground. Stretch two strands of No. 9 wire, the lower one 30 inches above the ground and the upper one 18 inches above the lower one, on the post to form a trellis.

The plants should be trained on the wires as illustrated in figure 17. When the plants are set out, cut them back to two buds. After growth starts in the spring the weaker of the two shoots should be removed, leaving the stronger one to form the trunk of the plant. At the end of the first growing season tie the cane in an upright position to the two wires, cutting it back if necessary at the top wire. At the end of the second growing season select four canes, two to the right (one on each wire) and two to the left of the trunk, and cut them back to 8 to 10 buds and tie them to the wires. Cut all other canes back to two buds.

The amount to prune a grape plant will be determined by such factors as age, variety, and vigor of vine. Such strong growing varieties as Concord and Niagara are not pruned as much as weaker growing varieties such as Delaware and Catawba. In pruning it must be borne in mind that the fruit is produced from buds on the one-year-old wood. Therefore, select four well developed medium sized one-year-old canes, two to the right, and two to the left of the trunk to produce the next season's crop. On the stronger growing plants cut these four canes back to 10 to 15 buds each and on the weaker plants cut them back to 8 to 10 buds each. All other growth should be removed except that some of the other one-year-old canes on the trunk may be cut back to two buds, as they may be needed to produce canes for the following year's crop.

Figures 17 and 18 show a bunch grape plant before and after pruning.

Muscadine Grapes

The growth and fruiting habits of the muscadine grapes are different from those of the bunch grape. For these reasons the training and pruning are different. The training is the same as for the bunch grape except that 3 or 4 wires are necessary to form the trellis. This, of course, necessitates longer posts as the wires are spaced about 18 inches apart. In the case of the muscadine the canes (arms) on the trellis are permanent and do not have to be renewed each year. Furthermore, they are cut back to a length of from four to six feet. After the frame work of the plant is established the pruning consists of the cutting back of all the one-year-old wood to two to four buds. Figures 19 and 20 illustrate a muscadine plant trained to the 8-cane Kniffin system before and after being pruned.

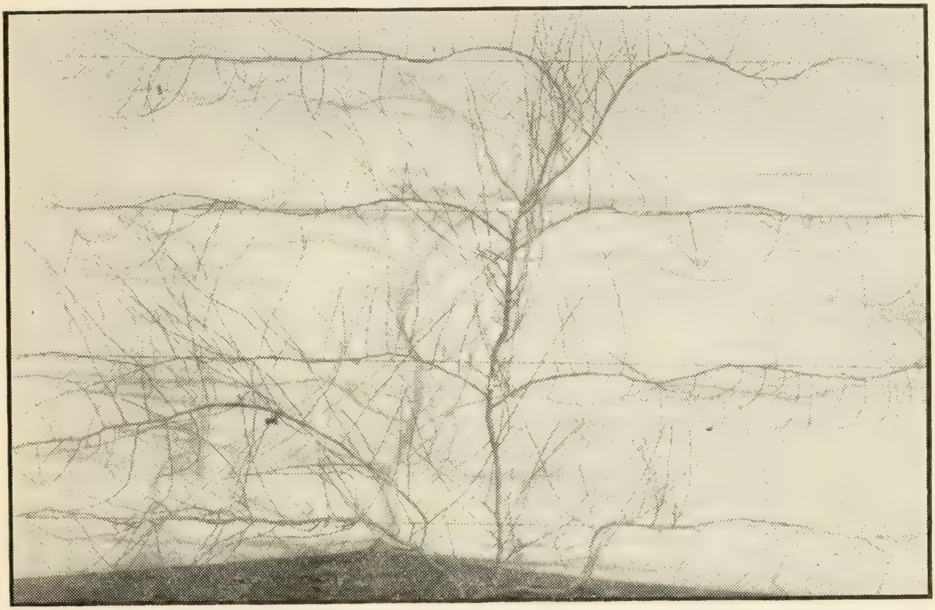


FIGURE 19—A muscadine plant trained to the 8-cane kniffin system (before pruning).

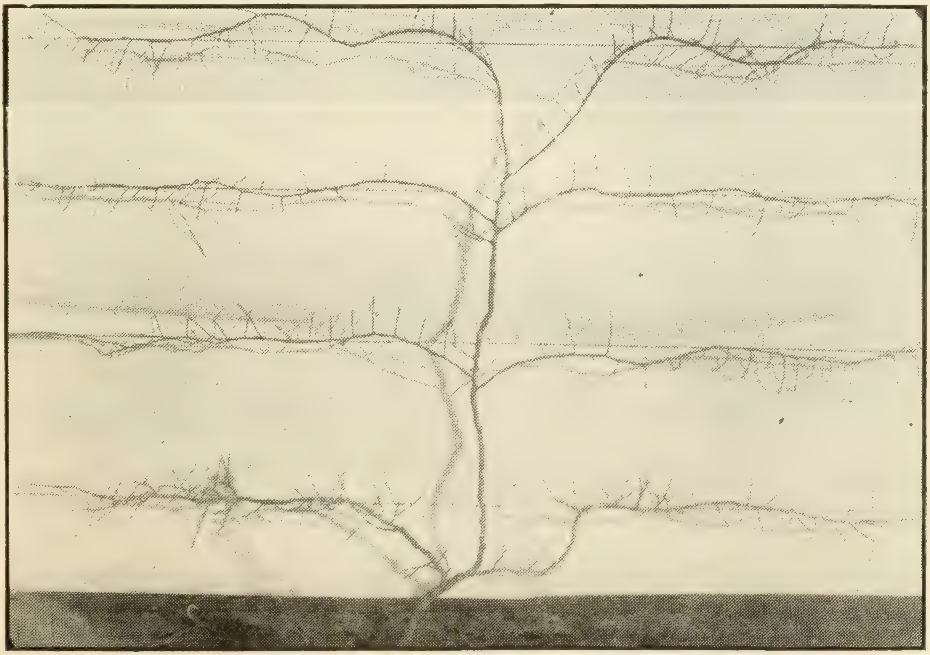


FIGURE 20—The same muscadine plant as that shown in figure 19 after being pruned. Note that all the new growth was cut back to two to four buds.

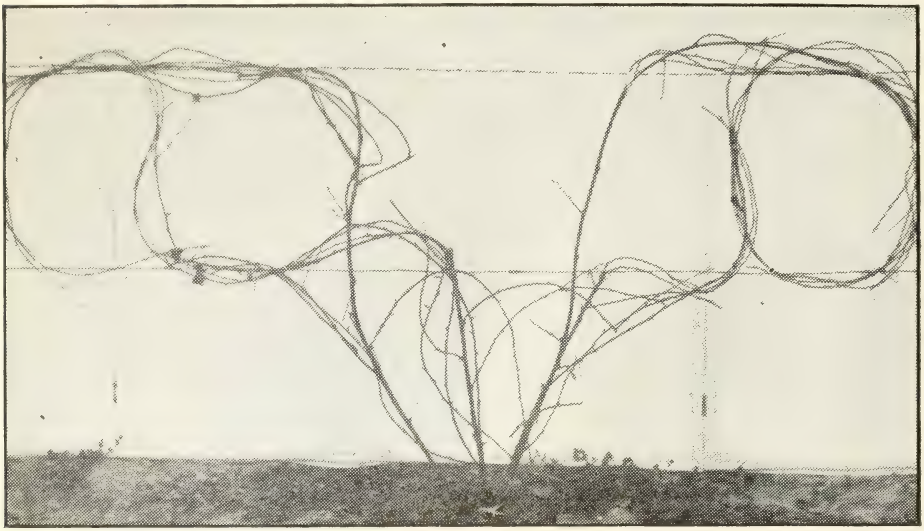


FIGURE 21—A Boysenberry plant trained to the 2-wire vertical trellis.

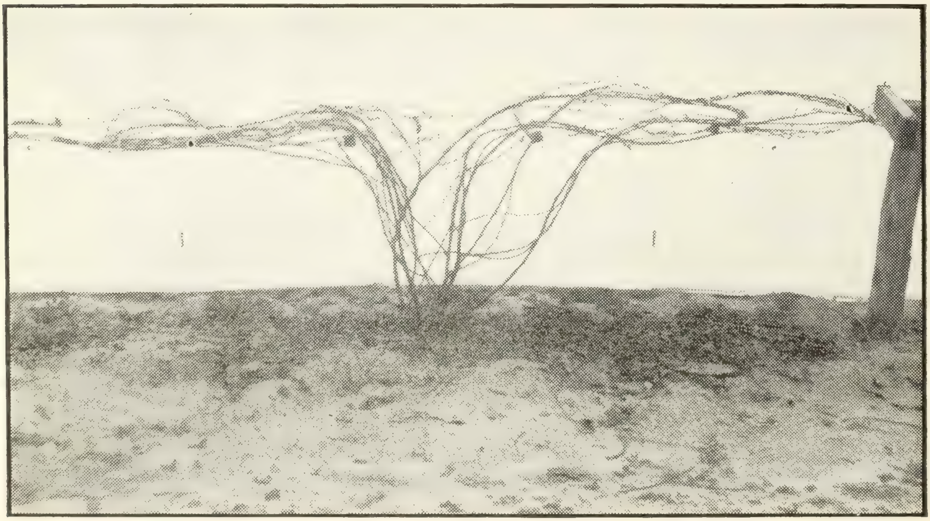


FIGURE 22—A Boysenberry plant trained to the 2-wire horizontal trellis.

TRAINING AND PRUNING BRAMBLES

The brambles include blackberries, dewbarries, raspberries, Youngberries, and Boysenberries. Raspberries are not successfully grown in Mississippi. Blackberries and dewberries grow in such profusion in the wild state in most sections of the State that they are seldom grown under cultivation. For these reasons only the hybrid varieties, Youngberries and Boysenberries, are included in this discussion.

Both the Youngberry and Boysenberry have a trailing type of growth, which necessitates some form of support for the canes if the best fruit is to be obtained. The support may be in the form of a single stake, two-wire vertical trellis, or two-wire horizontal trellis as that shown in figures 21 and 22. When the stake system is used, the stake should extend above the ground four to five feet. The two-wire vertical trellis is identical with that described for bunch grapes and the two-wire horizontal trellis is made by stretching two wires 24 inches apart and 30 inches from the ground, with the supports set 20 feet apart in the row.

Youngberries and Boysenberries grow canes one year, and these produce fruit the second year. Therefore, during the second season and thereafter the plants will be producing fruit from one-year-old canes and at the same time growing new canes from the roots of the plants for the crop the following year. As soon as the fruiting season is over all the old fruiting canes should be removed and burned, leaving only the new growth. In the southern part of the State the practice is quite often to remove the old and new canes and burn them in order to destroy diseases and insects. This practice is questionable in the northern part of the State where the ripening season is later, thereby reducing the length of time to produce the second crop of new shoots for the fruit crop the following year.

PRUNING EQUIPMENT

It is impossible to do efficient pruning unless good pruning equipment is avail-

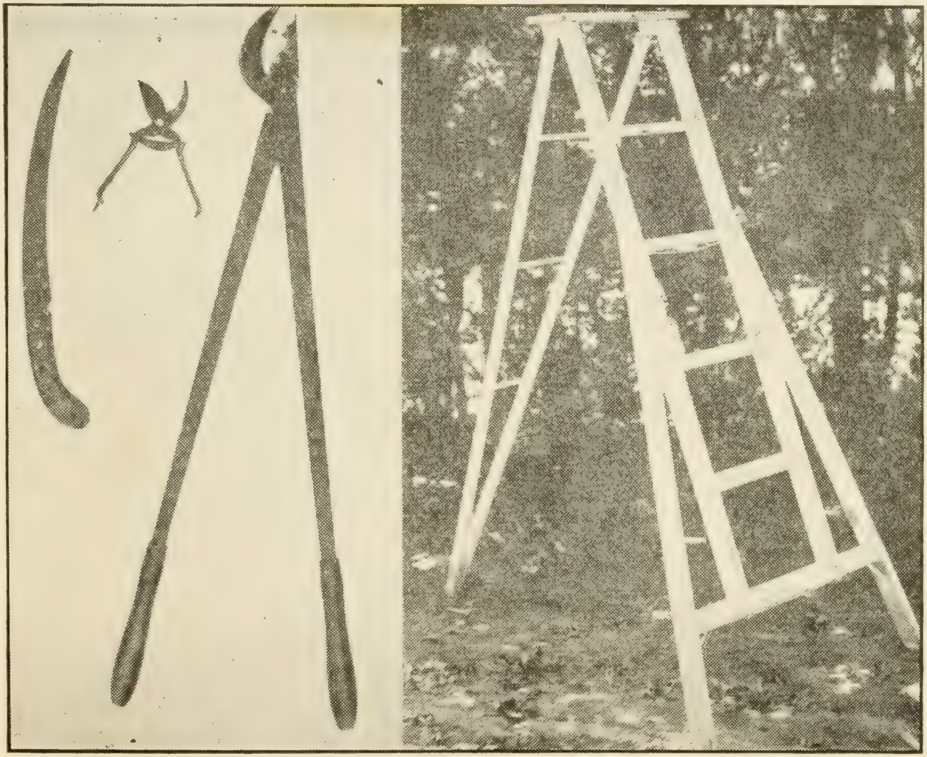


FIGURE 24—From left to right, curved saw, hand shears, long-handled shears or "loppers" and step ladder.

able. With the wide variety of makes, sizes and shapes of pruning tools obtainable it is sometimes difficult for the inexperienced orchardist to make a wise selection of pruning equipment. Figure 24 illustrates a curved saw, hand shears, long-handled shears or "lopper" and a step ladder. All this equipment is not necessary while the plants are young. At this time most of the pruning may be accomplished with only the hand shears. As the trees become older and increase in size it will be necessary to use the saw and long-handled shears to remove larger limbs.

ORCHARD SOIL MANAGEMENT AND FERTILIZATION

Fruit crops, as do other crops, require good soil management and fertilization in order to produce large crops of high quality fruit. Productive fruit trees may be characterized by an abundance of large dark green leaves, shoot growth of good length and thickness, healthy tree trunks and scaffold limbs, and an adequate supply of well developed fruit buds and fruit spurs.

The system of soil management to be practiced will be determined largely by the topography of the land, the type of soil, and the kind of fruit grown.

It should be pointed out that regardless of the system of culture used certain factors such as maintaining the nitrogen supply, improving the physical condition of the soil, and the addition of organic matter to increase the water holding capacity of the soil must be considered. Any system of culture which tends to keep the soil free of any cover will reduce the nitrogen supply of the soil, deplete the organic matter and promote the erosion of the soil, and will eventually result in poor tree growth with the production of small crops of poor-sized fruits.

Systems of Soil Management

Strip Cultivation

By this system of culture a portion of the area between the tree rows is cultivated, leaving the remaining area to grow

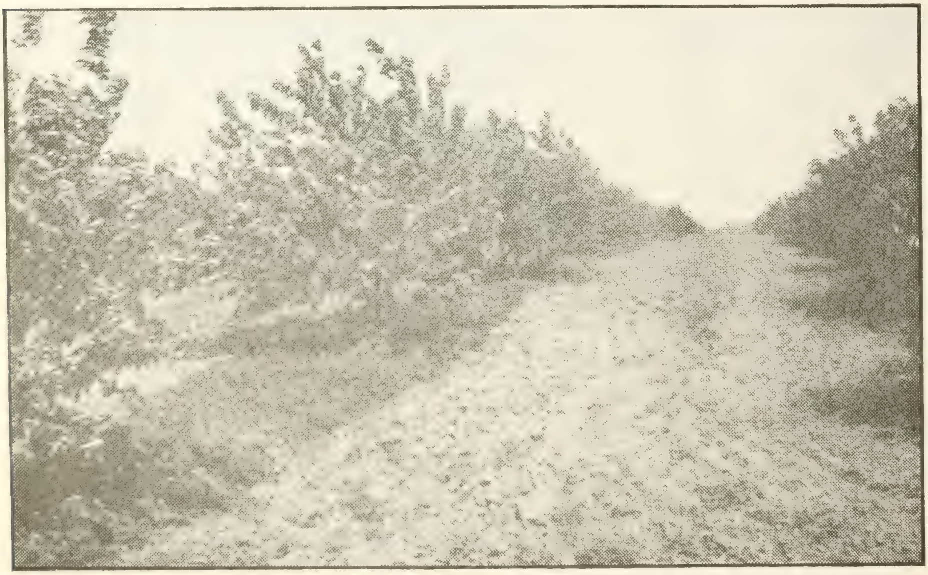


FIGURE 25—A system of strip cultivation may be used to an advantage in the orchard, especially on rolling land.

a cover for the protection of the soil. While the trees are young, especially with peaches, it is better to cultivate that area immediately adjacent to the trees, leaving an area between the tree rows 8 to 10 feet wide to grow the cover crop. After the trees come in to production and are well established it is better to leave that area adjacent to the trees uncultivated, as shown in figure 25. If such cover crops as bur clover or vetch are used they will often produce enough seeds on the uncultivated area to grow a good cover the following year. Grass and weeds should be controlled by the use of a mowing machine.

A system of strip cultivation on rolling land and where the trees are planted on the contour offers the distinct advantage of controlling to a great extent the erosion of the soil. Furthermore, the use of legume cover crops will add nitrogen to the soil and organic matter will be added, which will increase the water holding capacity of the soil.

Clean Cultivation with Cover Crops

On level land, a system of clean culture throughout the growing season with a winter cover crop sown in the fall to be turned under the following spring may be used to an advantage. By such a system all grass and weeds are destroyed, thus reducing to a minimum the competition for moisture and plant foods during the summer months. In addition, legume cover crops, when turned under, will add nitrogen and organic matter to the soil. Figure 26 illustrates a growth of vetch just before being turned under.

Intercropping

During the early life of the orchard while the trees are small and do not need all the space, such cultivated crops as beans, tomatoes, Irish potatoes, cabbage or any other low growing crop may be grown between the tree rows to supplement the income from the orchard until the trees come in to bearing. Where

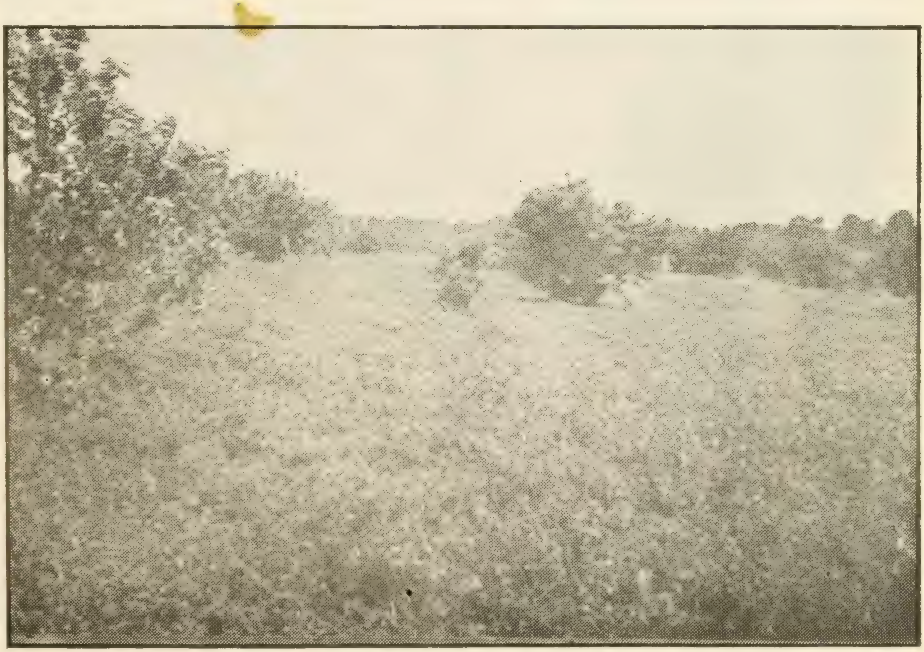


FIGURE 26—Hairy vetch makes an ideal winter cover crop in some sections of the state. Other legume cover crops are equally as good in other sections.

such practices are followed it is important that ample space be left on either side of the trees to protect them. The tree rows should be cultivated along with the crop grown. With this system a winter cover crop may be sown in the fall to be turned under the following spring.

Orchard Fertilization

The amount and kind of fertilizer to apply to fruit trees will be determined by such factors as age, vigor and kind of trees, kind of soil, and production records. Trees which are making little growth, producing few fruits and having small yellow leaves will need heavier applications of fertilizer than those making good growth, producing large crops of fruit, and having large green leaves.

The kind of fertilizer to use will depend primarily upon the type of soil. When the orchard is placed on a deep loam soil containing large amounts of organic matter, seldom will anything except applications of nitrogen-carrying fertilizers be necessary. On the other hand, if the soil is of a light sandy loam type, applications of phosphorus, potassium and nitrogen-carrying fertilizers will be needed. A much better cover crop will be grown on the lighter type soils if applications of phosphorus and potassium are made.

Because each orchard presents a different problem it is impossible to state specific recommendations as to the amount and kind of fertilizer to use. Therefore the suggestions given should be modified to meet the individual requirements.

Apples

Bearing apple trees should make an average yearly terminal growth of from 10 to 14 inches and young non-bearing trees a growth of 18 to 30 inches. In general, annual applications of from one-fourth pound to one-half pound of a nitrogen-carrying fertilizer such as nitrate of soda or sulphate of ammonia for each year of age of the tree is sufficient. Where the trees are in a poor state of vigor, applications of five to eight pounds of complete fertilizer on 10- to 12-year old trees in addition to the nitrogen should be beneficial, increasing or decreasing the amount of complete fertilizer as determined by the age and vigor of the tree. In order to prevent too much leaching of the fertilizer, two applications of equal quantities should be made, the first 10 days to two weeks before the blossom buds show pink and the second immediately after the fruit set, which is usually about six weeks after full bloom.

Pears

Because pears are rather susceptible to fire blight they should not make as vigorous a growth as the other fruits. Slow growing trees are not as susceptible to fire blight as are fast growing ones. Where the pears are growing in sod they should receive small amounts of quickly available nitrogen-carrying fertilizer, such as nitrate of soda, about one month before growth starts. This will aid in the setting of fruit and promote early vegetative growth. Later in the season the grass sod will check growth of the trees and encourage hardening of the wood, thus making the trees more resistant to fire blight. In cultivated orchards it is doubtful that any fertilizer should be applied to pears.

Peaches and Plums

Enough fertilizer should be applied to these fruits to cause a terminal growth of from 16 to 24 inches. On the better soils, annual applications of from three to four pounds of nitrate of soda or its equivalent applied to five to seven year old bearing trees is usually sufficient. The amount should be decreased or increased as determined by the age and vigor of the tree. On the poorer soils, four to five pounds of complete fertilizer should be used in addition to the nitrogen-carrying fertilizer. The fertilizer should be applied in two applications as with apples; that is, one-half the amount applied about two weeks before the blossom buds show color and the remainder just after fruit set.

Grapes and Brambles

On most soils grapes and brambles should receive applications of a complete fertilizer which is high in nitrogen, such as 6-8-4. Usually two to three pounds per plant per year applied in two applications as with apples is sufficient.

Strawberries

While the soil is being prepared and just before setting the plants, applications of from 200 to 400 pounds of a complete fertilizer such as 6-8-4 should be made per acre, or from about 2 to 3 pounds per 100 feet of row. The following September a like amount of complete fertilizer should be applied to stimulate fruit bud formation, and a third application of from 300 to 400 pounds per acre should be made in January to stimulate vegetative growth and to increase the fruit set.

In applying the fertilizer to the tree

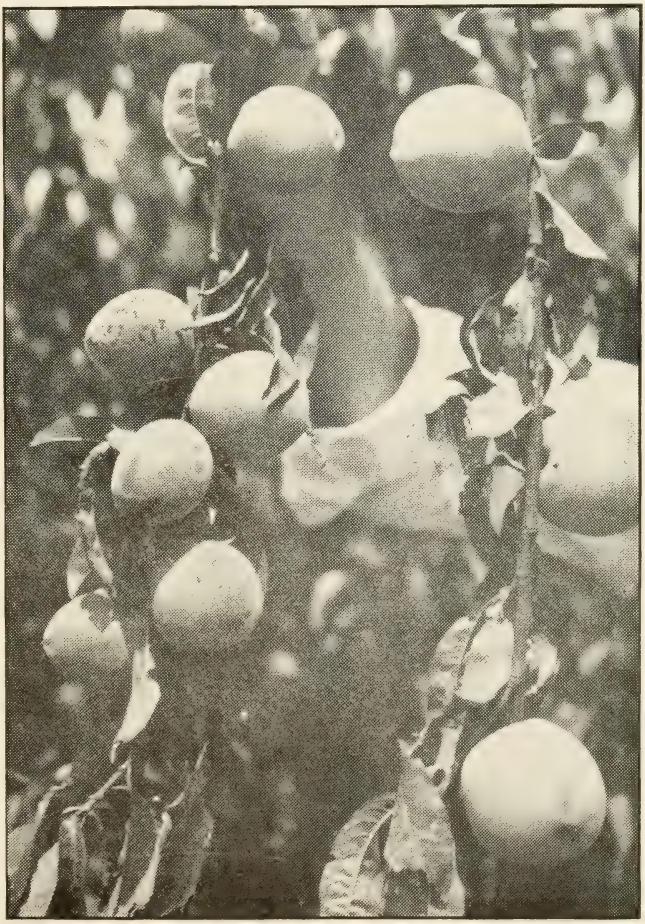


FIGURE 27—Showing the effect of thinning on size of fruit. The fruits on the thinned trees (on right) are larger and of more uniform size and color. Note the curculio damage to the fruit on the extreme upper left of the unthinned branch, held beside the thinned fruit for comparison. Such fruits should be removed during the thinning operation.

fruits it should be broadcast underneath and extend out beyond the spread of the branches, as the feed roots of the plants will extend some distance further than the branches.

FRUIT THINNING

Fruit thinning is the removal of a portion of the fruit crop in order that maximum yields of high quality fruit may be secured. It is a recognized orchard practice among the better fruit growers, and if good fruit is to be produced, the thinning operation is as indispensable as pruning, spraying, and soil fertilization.

Systematic thinning will result in fruits of larger size with more color, quality and uniformity, prevent the breaking of limbs, aid in the control of insects and diseases, reduce handling costs at harvest time, and help maintain the vigor of the trees.

Effects of Fruit Thinning

Effect of thinning on size, color, quality and uniformity of fruit. The greatest advantage resulting from fruit thinning is the increased size secured. (See figure 27). With the removal of a portion of the crop from the tree, more nutrients are available per fruit for the remaining fruits. When thinning is properly done the increase in size of the remaining fruits will offset the decrease in the number of fruits, so that no decrease in yield will result.

Most fruits, such as apples, peaches and plums, require sunlight for the development of the red color. By removing the fruits from the densely shaded portions of the tree the remaining fruits are exposed to more sunlight. Furthermore, heavily loaded branches which are properly thinned will assume a normal position, thereby preventing the lower branches from becoming shaded. Figure 28 illustrates a peach tree so heavily loaded with fruit that the upper limbs have completely covered the lower ones, and are thus preventing the sunlight from reaching the fruit.

Effect on limb breakage. It is not uncommon in years of a heavy crop for a fruit tree to produce so much fruit that it causes the limbs to break. This damage is often such that the tree is per-

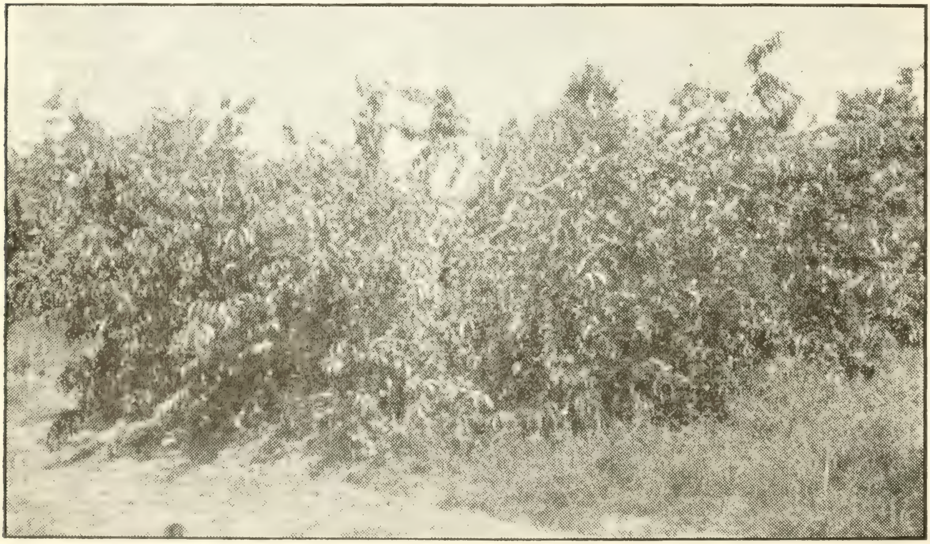


FIGURE 28—This peach tree is so heavily loaded with fruit that it has caused the upper limbs to bend down and completely cover the lower ones. This would not have occurred had the fruit been properly thinned.

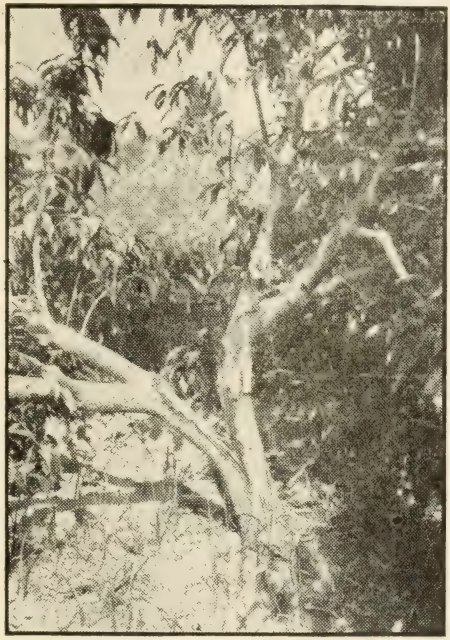


FIGURE 29—This young peach tree damaged beyond repair, as a result of poor training, an overload of fruit, and a high wind.

manently ruined. Figure 29 shows a young tree which is damaged beyond repair as a result of poor training, too much fruit, and a high wind. Proper thinning would have greatly reduced the load of fruit on this tree and probably prevented the damage.

Effect on disease and insect injury. During the thinning operation, all diseased and insect injured fruit should be removed so that none of it is present at harvest time to increase the cull pile. The removal and destruction of injured fruit helps to control insects and diseases. It also permits a better coverage of spray materials, further aiding in disease and insect control.

Effect on harvest costs. Since the fruits on the thinned trees will be of greater average size than those on the unthinned trees, it will require less time to harvest any definite amount of fruit from the thinned trees, thereby reducing the harvesting and handling costs per bushel of fruit.

Effect on vigor of trees. The production of a heavy crop of fruit will deplete the food reserves of the tree and quite often result in a light crop the following year. In order to maintain the vigor of the tree, large crops of small fruits should not be allowed to mature. It requires practically as much food material to produce the seed in a small peach as that in a large peach, and if the tree is allowed to mature large crops of small fruits it will soon become devitalized and unproductive.

Time of Thinning

Fruit thinning should be done as soon after the final drop as possible, which is usually about six to eight weeks after full bloom. At this time the fruits of the peach will be about three-fourths inch in diameter, and those of the apple about one inch in diameter. Early thinning is highly desirable because it will conserve the nutrients that go into the development of the fruits and is therefore less devitalizing on the plant than is late thinning.

Method and Amount of Thinning

Thinning of the fruit should be done by hand. Shears and similar small tools require more time than hand thinning, and there is the added hazard of injury to the fruit that is to be left on the tree. All small, deformed fruit, and all insect or disease injured fruit should be removed.

The amount to thin will depend largely on the kind of fruit and the vigor of the tree. Fruits on peach trees of average vigor are usually thinned to an average of 4 to 6 inches apart, plums 2 to 4 inches apart, apricots far enough apart so that they will not touch when ripe, apples and pears 6 to 8 inches apart, with one fruit per cluster on the older trees and two fruits per cluster on the young vigorous trees. Such fruits as grapes and brambles are thinned entirely by the dormant pruning because they are too small to make it economically feasible to remove the individual fruits.

INSECT AND DISEASE CONTROL

The control of insects and diseases is one of the most important factors in successful fruit production. If other orchard operations such as pruning, cultivation and fertilization are efficiently done and spraying is left undone, few if any good fruits will be produced. The most efficient means of controlling insects and diseases is by spraying, and to be effective it is very important that it be thorough, of the correct materials and applied at the proper time. If the pest attacking the fruit plants is to be successfully combated it is necessary that the grower have some knowledge of its nature and how it affects the plant.

The recommended spray mixtures should be followed closely since the chemicals used in preparing them may injure the plant if not properly used. In some instances injury from the spray materials may result. Such factors as vigor of plant variety, climatic conditions, time, method and amount of materials applied will determine to some extent the damage caused from spraying.

Spray materials may be classified according to the season of application and to the purpose of application.

1. According to season

(a) Dormant—Those applied during the winter and early spring while the plants are dormant.

(b) Summer—Those applied while the plants are in leaf.

2. According to purpose

1. Insecticides

(a) Stomach poisons—for the control of insects with chewing mouth parts, such as plum curculio or potato beetles.

(b) Contact sprays—for the control of insects with sucking mouth parts, such as San Jose scale or plant lice.

(c) Repellants—for protecting the plants against insects of both types. They do not actually kill the insects.

(d) Fumigants—for controlling all types of insects by fumigation.

2. Fungicides—Materials used for the protection against fungous diseases such as brown rot of peaches, black rot of grapes, and bitter rot of apples.

3. Combination sprays—Combined preparations for controlling fungi and insects with chewing or sucking mouth parts.

Spray Schedules

The dormant spray for apples, peaches, plums and pears for the control of scale consists of one gallon of 66 per cent oil emulsion (Government formula) mixed with 20 gallons of water. If peach leaf curl was prevalent on the peach trees the previous year they should be sprayed with one gallon of oil emulsion mixed with 15 gallons of 3-3-50 Bordeaux mixture, instead of the oil emulsion alone. Bordeaux mixture is composed of copper sulphate (blue stone), hydrated lime, and water. Powdered copper sulphate (instant Bordeaux) should be used since it is easily dissolved in water. To make a 3-3-50 Bordeaux mixture fill a 50-gallon spray tank about one-fourth full of water and while stirring add slowly 3 pounds of powdered copper sulphate and continue filling the tank. When the tank is about two-thirds full sift in 3 pounds of hydrated lime, continue stirring the solution and add water to make 50 gallons of spray material and use immediately. Follow a similar procedure in preparing Bordeaux mixture according to other formulas recommended.

Peaches and Plums

Spring and Summer Sprays

First cover—The first cover spray should be applied when three-fourths of the petals (showy part of the flower) have fallen from the blossoms. It consists of 1 pound of arsenate of lead, 4 pounds of hydrated lime and 4 pounds of commercial zinc sulphate mixed with 50 gallons of water. It has been shown that zinc sulphate will greatly reduce arsenical injury and its use is therefore recommended.

Second cover—The second cover spray should be applied 10 days after the first, using the same materials. Both these sprays are very important and should be applied as indicated since they are for the control of the plum curculio (the worm so often found in the fruit).

Third cover—Two weeks after the second spray an application of sulphur should be made for the control of brown rot. Wettable sulphur which is sold under several brand names is recommended since it readily mixes with water and is easy to apply. The dilution as recommended by the manufacturer should be followed closely. The usual recommendation is 3 pounds of wettable sulphur with 50 gallons of water.

Fourth cover—A second application of wettable sulphur should be made three to four weeks after the third cover spray or about four weeks before the fruit ripens, adding to this material one pound of arsenate of lead, 4 pounds of hydrated lime and 4 pounds of zinc sulphate with each 50 gallons of spray for the control of the plum curculio, and to some extent, the oriental fruit moth.

Fifth cover—On late ripening varieties of peaches such as Elberta a fifth spray consisting only of sulphur should be applied 15 days before the fruit ripens to guard against brown rot. In such instances the fourth cover spray should be applied three or four weeks after the third spray.

Apples and Pears

Spring and Summer Sprays

First cover—When one-third the blossoms have opened, spray with a 1-3-50 Bordeaux mixture to reduce fire blight.

Second cover—When three-fourths the petals have fallen, apply a 3-4-50 Bordeaux mixture plus 1 pound of arsenate of lead with each 50 gallons of spray.

Third cover—Two weeks after the second cover, an application of 4-4-50 Bordeaux plus 1 pound of arsenate of lead should be applied. If plant lice are attacking the young apple twigs add to the above spray one-half pint of nicotine sulphate (Black Leaf 40).

Fourth cover—Repeat the third cover spray two to three weeks later.

Fifth cover—Repeat the third cover spray three to four weeks after the fourth cover spray.

Grapes

Winter and Summer Sprays

Dormant spray—During the winter months while the vines are dormant, spray with a 3-3-50 Bordeaux mixture for the control of anthracnose and black rot. If scale is present add to each 15 gallons of Bordeaux mixture 1 gallon of 66 per cent oil emulsion.

First cover—Just before the blossoms appear an application of 3-3-50 Bordeaux mixture should be applied to which has been added 1 pound of arsenate of lead.

Second cover—Just after the blooms have fallen repeat the first cover spray.

Third cover—Repeat the second cover spray two weeks later.

Fourth cover—Repeat the third cover spray two to three weeks later. If leafhoppers or plant lice are present add one-half pint nicotine sulphate with each 50 gallons of spray.

Strawberries

A great many insects and diseases attacking strawberries can be controlled to a large extent by proper cultural methods. Sanitary measures such as keeping the planting free of grass and weeds, providing good drainage of soil and removing all diseased and insect damaged plants are especially desirable.

Leaf spot and leaf scorch may be successfully controlled by spraying with a 3-4-50 Bordeaux mixture. The first application should be made just before growth starts in the spring. Continue the applications at intervals of 10 days to two weeks until four to six applications have been made.

CONDENSED SPRAY SCHEDULES

Peaches and Plums

Time of Application	Purpose	Spray Material
Apply in fall after leaves have dropped or in spring before buds swell	Used against San Jose scale and leaf curl	One gallon 66 percent oil emulsion mixed with 15 gallons 3-3-50 Bordeaux mixture. If no curl is present use one gallon oil emulsion with 20 gallons of water.
First cover—when ¾ the petals have fallen	For plum curculio	1 pound arsenate of lead, 4 pounds hydrated lime, 4 pounds zinc sulphate mixed with 50 gallons water.
Second cover—10 days after first cover	For plum curculio	Same as first cover.
Third cover—Two weeks after second cover	For brown rot	Wettable sulphur at manufacturer's recommendation, usually 3 lbs. with 50 gallons of water.
Fourth cover — Three to four weeks after third cover, or about 4 weeks before fruit ripens	For brown rot, plum curculio and oriental fruit moth	Same as third cover plus 1 pound arsenate lead, 4 pounds hydrated lime and 4 pounds zinc sulphate.
Fifth cover—15 days before fruit ripens. For late ripening varieties.	For brown rot	Same as third cover

Grapes

Time of Application	Purpose	Spray Material
Apply in fall after leaves have dropped or in spring before buds swell	For anthracnose, black rot and scale	One gallon 66 percent oil emulsion mixed with 15 gallons 3-3-50 Bordeaux mixture. If no scale is present omit the oil.
First cover—Just before blossoms appear	Anthracnose, black rot grape berry moth and leaf eating insects	3-3-50 Bordeaux mixture plus 1 pound arsenate lead
Second cover—Just after blossoms have fallen	Same as first cover	Same as first cover
Third cover—Two weeks after second cover	Same as first cover also leafhoppers	Same as first cover plus ½ pint nicotine sulphate
Fourth cover—Two to three weeks after third cover	Same as first cover also leafhoppers	Same as first cover plus ½ pint nicotine sulphate

Apples and Pears

Time of Application	Purpose	Spray Material
Apply in fall after leaves have dropped or in spring before buds swell	For San Jose Scale and general sanitation	One gallon 66 percent oil emulsion mixed with 15 gallons 3-3-50 Bordeaux mixture
First cover—When 1/3 the blossoms have opened	For blossom blight	1-3-50 Bordeaux mixture
Second cover—When 3/4 the petals have fallen	For codling moth, tent caterpillar, scab and pear leaf spot	3-4-50 Bordeaux mixture plus 1 pound arsenate lead
Third cover—Two weeks after second cover	Same as second cover also for bitter rot, blotch and plant lice	4-4-50 Bordeaux mixture plus 1 pound arsenate lead and ½ pint nicotine sulphate if plant lice are present.
Fourth cover—Two to three weeks after third cover	Same as third cover	Same as third cover
Fifth cover—Three to four weeks after fourth cover	Same as third cover	Same as third cover

Strawberries

Time of Application	Purpose	Spray Material
First cover—Just before growth starts	Leaf spot and leaf scorch	3-4-50 Bordeaux mixture
Second cover—Ten days to two weeks after first cover	Same as first cover	Same as first cover
Third cover—Ten days to two weeks after second cover	Same as first cover	Same as first cover
Fourth cover—Ten days to two weeks after third cover	Same as first cover	Same as first cover
Fifth cover*—Ten days to two weeks after fourth cover	Same as first cover	Same as first cover
Sixth cover*—Ten days to two weeks after fifth cover	Same as first cover	Same as first cover

*Shoud not be applied unless condition of plants deem it necessary.

DO'S IN SPRAYING

1. Weigh or measure all spray materials and follow directions.
2. Make a thorough application of the right material at the right time.
3. Secure the spray material well in advance of the time for application.
4. Be prepared. Clean all equipment immediately after use in order that it may be ready for the next spraying.

DON'TS IN SPRAYING

1. Don't use dry lime sulphur, liquid lime sulphur, or Bordeaux mixture on peaches and plums when they are in leaf.
2. Don't let the dust blow or drift on fruit trees when dusting cotton with calcium arsenate.
3. Don't use oil emulsion except during the dormant season.
4. Don't over-spray the plant. It will cause injury.
5. Don't try to spray with dirty spray equipment.
6. Don't try some new spray material unless it is recommended by an authority.

Peach Tree Borer Control

The peach borer is one of the most serious pests attacking the peach tree. Its presence is indicated by a gum or jelly-like substance at the base of the tree near the ground line. It may be controlled by the use of paradichlorobenzene (P. D. B.), ethylene dichloride emulsion, or by picking the borers out with a knife commonly known as "worming."

Paradichlorobenzene (P.D.B.) Treatment—This chemical is a white crystalline material, insoluble in water, with an odor resembling that of ether. The crystals

TABLE 2—DILUTION OF STOCK EMULSION, STRENGTH OF DILUTED EMULSION, DOSAGE APPLIED TO TREES OF DIFFERENT AGES, AND APPROXIMATE NUMBER OF TREES ONE GALLON OF 50 PER CENT ETHYLENE DICHLORIDE EMULSION WILL TREAT*

Age and Size of Trees	Quantity of Water and of Stock Emulsion to Use to Get 10 Gallons of Diluted Emulsion		Strength of the Diluted Emulsion	Dosage of the Diluted Emulsion for Each Tree	Approximate No. of Trees One Gal. 50% E.D.E. Will Treat
	Water	50% Stock Emulsion			
Six years and older (average size and larger trees)	Gallons 5	Gallons 5	Percent 25	1/2 pint	32
Six years and older (small size trees)	6	4	20	1/2 pint	40
Four and five years	6	4	20	1/2 pint	40
Three years	7	3	15	1/2 pint	53
Two years	7	3	15	1/4 pint	106
One year	8½	1½	7½	1/8 pint	426

*Adapted from table 1—Ethylene Dichloride Emulsion for the control of the Peach Borer, by Oliver I. Snapp, U. S. D. A. Bu. of Ent. and Plant Quarantine, E424, March, 1938.

should have a fineness similar to that of common salt. The material vaporizes slowly at ordinary temperatures, and under high temperature and dry soil conditions vaporizes more readily.

P. D. B. may be used safely on peach trees 4 years of age and older. On younger trees severe injury may result from its use. On 4 or 5 year old trees use three-fourths of an ounce per tree, and on 6-year-old and older trees one ounce per tree. The ground immediately about the base of the tree should be cleaned of grass and weeds without disturbing the soil any more than is necessary. Apply the proper amount of P. D. B. in a continuous band about 1 or 1½ inches wide around the tree and about 1 or 1½ inches from the trunk of the tree. Several shovelfuls of soil should be placed on the ring of crystals in the form of a mound and packed with the back of the shovel. The mound of soil should be removed in about 4 to 6 weeks depending upon the age of the tree. On 4 to 5 year-old trees remove the mound in 4 weeks; on older trees in 6 weeks.

The time of application is important if good control of the borers is expected. In North Mississippi the application should be made from October 5 to 10, in Central Mississippi from October 10 to 15, and in South Mississippi from October 15 to 20.

Ethylene Dichloride Emulsion (E. D. E.) treatment—The use of Ethylene Dichloride Emulsion has recently been found to be very effective as a control for peach tree borers. It has some distinct advantages over P. D. B. in that it may be used safely on young trees, is effective at low soil temperatures, may be used throughout the fall and spring, a minimum of soil preparation is necessary, and the mounds do not have to be removed. Table 2 gives the dilutions of the stock emulsion,, the strength of the diluted emulsion, the dosage applied to trees of different ages and the approximate number of trees one gallon of 50 per cent Ethylene Dichloride Emulsion will treat. Various manufacturers make the emulsion in different strengths, and their recommendations should be followed.

The proper dosage as recommended by the manufacturer of the emulsion should be applied by wetting the soil immediately surrounding the tree. No preparation of the soil is necessary on loose level ground. In some cases however, cupping the soil slightly toward the tree trunk to prevent the liquid from running off, or loosening the soil around the tree sufficiently to permit the liquid to be readily absorbed will give better results. Several shovelfuls of soil should be placed against the trunk of the tree after treatment to prevent surface loss of the fumigant. The treatment requires no later attention.

"Worming" treatment—Where a grower has only a few peach trees, the peach borer can probably be most satisfactorily controlled by worming. In this case the trees should have a mound of soil placed around the trunk about six inches high in early July. This will make it easier to locate the borers during the worming process in the fall. In November or December the mounds should be torn down and the worms removed with a sharp knife. During the worming process the cuts in the tree trunks should be made vertically so far as possible. After the tree has been wormed the soil should be placed back around the trunk of the tree for protection against freezing weather.

Spraying Equipment

The control of insects and diseases attacking the fruit plants can be no better than the spray equipment available. It is false economy to purchase and attempt to use equipment which is too small for the job. The smaller spray outfits are limited as to the volume of spray material discharged and as to the pressure obtained. On very small plantings their use is justified but on plantings of one-

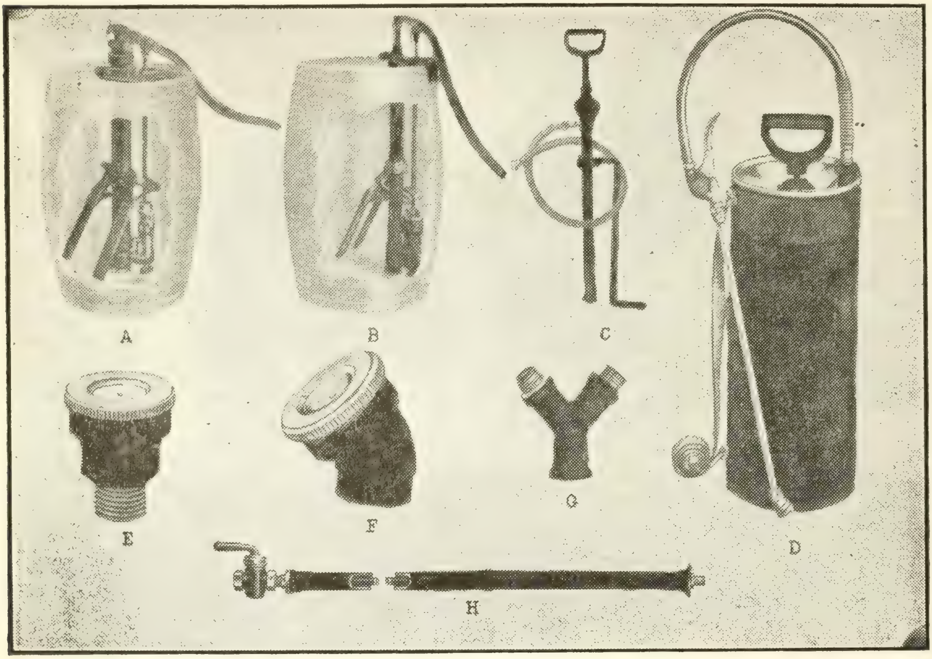


FIGURE 30—Illustrating various types of spray pumps and equipment. (A) heavy type barrel sprayer which fastens in the top of the barrel; (B) light type barrel sprayer which fastens on the side of the barrel; (C) bucket pump; (D) compressed air sprayer; (E) straight nozzle; (F) angle nozzle; (G) Y connection and (H) extension rod with cut off.

half acre or more nothing smaller than a barrel sprayer should be used.

Spray Outfits—Spray outfits may be classified under two general headings: (1) hand operated, and (2) motor driven outfits. Since only the hand operated outfits are needed for spraying the home orchard, they are discussed here.

The Compressed Air Sprayer — This sprayer as illustrated in figure 30-D, consists of a tank with a capacity of 3 to 4 gallons and a screw-in air pump and fitted with a strap for carrying on the shoulder when spraying. Pumping and spraying are done intermittently until the material is all sprayed out. It is easily transported and well suited to garden crops. It is too small and almost impossible to get good coverage when used for spraying fruit trees.

The bucket-pump—This pump, as illustrated in figure 30-C, is a small vertically operated pump for use in any convenient receptacle for the spray material such as a bucket, tub, or earthenware jar. It is most useful for small trees and groups of plants. It may be fitted with a long spray hose and an extension rod, thus extending its use to larger trees.

The barrel sprayer—This sprayer is usually of two sizes. The smaller size (figure 30-B) fastens to the side of the barrel while the larger size (figure 30-A) is fastened in the head of the barrel. They are essentially large type bucket pumps with a 2- to 3-inch brass or bronze cylinder and the plunger worked by the upward and downward movement of a lever or handle. Agitation is provided by swinging paddles or a dasher. They may be fitted with any length hose and are more efficient when two nozzles are used on the spray rod. They are usually operated at pressures ranging from 75 pounds to 100 pounds. Their use is very satisfactory on plantings up to two acres hence are very desirable for controlling insects and diseases of the home orchard.

Spraying Accessories — Most spray pumps are sold with a minimum of accessories. In order to get good coverage of the fruit plants with the least effort it is desirable to have the barrel pump equipped with a 25 foot hose, cut-off, extension rod, Y connection and two nozzles. Figure 30 shows an extension rod equipment with a cut-off, also nozzles of both the straight and angle type and a Y connection. The angle type nozzles are usually preferred, and with a Y connection two of them may be very satisfactorily used on the spray rod.

FRUIT VARIETIES

The problem of selecting fruit varieties for planting in the home orchard should be given careful attention. Success or failure of the orchard is often determined through the selection of the varieties.

Varieties of fruits selected for planting should be adapted to the conditions under which they are grown, suitable for the purpose for which they were planted, and should ripen over as long a period as is practical in order to provide a continuous supply of fruits.

The varieties of fruits listed and described in tables 3, 4, 5, and 6 have been selected on a basis of their behavior at the Mississippi Experiment Station and in other sections of the State. It should be pointed out that the Mississippi Station and other Southern Experiment Stations are doing a great deal of work in the breeding of fruits for the purpose of developing new varieties which are better adapted to southern conditions. Therefore, as the newer varieties prove their superiority to the older ones they should be selected for planting.

FIG VARIETIES

Celeste—This is the most popular fig variety grown in Mississippi. The plants are vigorous, hardy and produce good crops of fruit; fruit is small to medium, pear shaped, ribbed; skin violet, sometimes shading to purplish brown; pulp whitish, shading to rose color at the center; very good quality. It begins to ripen the latter part of June and early July and continues for a period of three or four weeks.

Brown Turkey—Tree characters very similar to Celeste but not as hardy. Fruit medium to large, broadly pear shaped; skin coppery brown; pulp whitish, shading to pink about the seeds; quality good. Begins to ripen in early July and continues for about two months.

Magnolia—Grown for commercial purposes in the Gulf coast region of Texas but is not well adapted to Mississippi conditions. The plant is a rather weak grower and the fruit cracks badly. The fruit is large; skin greenish amber or pale green, quality good. Ripening season from mid-July until frost.

PEAR VARIETIES

Kieffer—Tree vigorous, productive, upright; fruit medium to large, oval, narrowing toward both ends; skin yellow, sometimes with red cheek, thick and tough; flesh coarse, juicy and of poor quality unless properly ripened. Good for canning, especially preserves. Ripens in August and September.

LeConte—Very similar to Kieffer except ripens three to four weeks earlier.

Pineapple—Tree productive, vigorous, upright; fruit large, tapering toward both ends, round; skin thick, tough, creamy yellow with conspicuous dots; flesh firm, crisp, coarse and fairly juicy. Good for canning and preserves, but poor as dessert. Ripening season, August.

STRAWBERRY VARIETIES

Southland—Plants exceptionally vigorous and free of disease. Runner production is ample to make matted rows. Fruit soft and adapted only to home use.

TABLE 4—RECOMMENDED APPLE VARIETIES

Variety	COLOR		Ripening Date	Uses	Production
	Skin	Flesh			
Yellow Transparent	Yellow	White	June 1-20	Fair for eating, baking and salads, good pies, excellent sauce	Good
Early Harvest	Yellow	White	June 1-20	Good for eating, baking, pies and salads, excellent sauce	Good
Eckles	Red Striped	White	June 5-25	Excellent for eating and salads Poor for sauce. Fair for baking and pies.	Excellent
Red Astrachan	Red	White	June 15-July 15	Good for eating, baking, pies, salads, and sauce.	Good
Red June	Red	White	June 15-July 15	Good for eating, baking, pies, salads and sauce.	Good
Summer Horse	Yellow	White	July 15-Aug 15	Good for pies, baking and sauce. Fair for eating and salads.	Good
Cauley	Yellow	White	Aug. 1-30	Fair for eating and salads. Good for sauce, baking, and pies .	Excellent
Delicious	Red	Creamy Yellow	Aug. 10-Sept. 10	*Excellent for eating and salads. Good for sauce. Fair for baking and pies.	Good
Golden Delicious	Yellow	Creamy Yellow	Aug. 15-Sept. 15	*Excellent for eating and salads. Good baking, fair for pies and sauce.	Good
Winesap	Bright Red	Creamy Yellow	Sept. 1-30	*Good for eating, baking, pies, salads, and sauce.	Good
Stayman Winesap	Red	Creamy Yellow	Sept. 10-Oct. 10	*Excellent for baking, pies, and sauce. Good for eating and salads.	Good

*From National Apple Institute.

TABLE 5—RECOMMENDED PLUM VARIETIES

Variety	COLOR		Stone Free or Cling	Ripening Date	Use	Production
	Skin	Flesh				
Methley	Deep Purple	Blood red	Cling	June 1-15	Excellent for table and local market	Excellent
Red June	Red	Yellow	Cling	June 20-30	Good for table use and local market	Good
Abundance	Red	Yellow	Cling	June 20-30	Fair for table use and local market	Excellent
Burbank	Dark Red	Yellow	Cling	June 20-30	Good for table use and markets	Excellent
Wild Goose	Bright Red	Light yellow	Cling	June 20-30	Fair to good for table use, market	Good
Satsuma	Red	Red	Cling	June 20-30	Excellent for table use, local market	Good

TABLE 6—RECOMMENDED BUNCH GRAPE VARIETIES

Variety	COLOR		Ripening Date	CLUSTER		Use
	Skin	Juice		Size	Compactness	
Campbell Early	Black	Red	July 5-10	Medium	Medium	Good for table, market and juices.
Moore Early	Black	Red	July 5-10	Medium	Medium	Good for table, market and juices.
Portland**	White	Straw	July 5-15	Medium	Medium	Good for table and market.
Delaware**	Red	Straw	July 15-25	Small	Compact	Excellent table and market grape.
Niagara**	White	Straw	July 20-30	Large	Medium	Good table and market grape.
Concord**	Black	Red	July 25-Aug. 5	Medium	Medium	Good table grape, market, juice.
Champanel	Black	Red	July 25-Aug. 5	Medium	Medium	Good for juice and jellies.
Extra	Black	Red	Aug. 1-10	Large	Medium	Good for table, market, and juice.
Catawba**	Red	Light Red	Aug. 5-15	Medium	Medium	Excellent table grape, market, juices
Muench	Black	Red	Aug. 10-20	Medium	Compact	Fair for table, market. Good juice.
MUSCADINE GRAPES*						
Eden	Black	Pink	Aug. 20-Sept. 10	Medium	Loose	Good for table use and juice.
Hunt	Black	Tawny	Aug. 25-Sept. 15	Medium	Loose	Good for table use and juice.
Scuppernong	White	Yellowish	Sept. 1-20	Small	Medium	Local markets, table and juices.
Thomas	Dark Purple	Tawny	Sept. 1-20	Small	Medium	For unfermented juices and preserves
James	Dark Purple	Pink	Sept. 10-30	Small	Loose	Local markets, table, juices and preserves
Mish	Black	Yellowish	Sept. 10-30	Medium	Loose	Local markets, table and juice.

**Should be grown on a root stock.

*Male vines are required for production of fruit in Muscadines.

TABLE 3—RECOMMENDED PEACH VARIETIES

Variety	COLOR		Stone-Free or Cling	Ripening Date	Uses	Production
	Skin	Flesh				
Mayflower	Greenish white Red cheek	White	Cling	May 20-June 5	Fair for table and local market	Excellent
Victor Early	Creamy white	White, Red Splashed	Semi-cling	May 25-June 10	Fair for table and local market	Good
Red Bird (Early Wheeler)	Red	White, Red Splashed	Cling	June 1-15	Fair for table and local market	Good
Alabama	Creamy white	White, Red Splashed	Semi-cling	June 1-15	Fair for table and local market	Excellent
Early Rose	Creamy white	White	Cling	June 5-20	Good for table and local market	Good
Arp Beauty	Yellow Red cheek	Yellow	Semi-cling	June 15-July 1	Good for table and local market	Excellent
Carman	Creamy white Red Splashed	White	Semi-free	June 25-July 10	Excellent for table and local market,	Good
Golden Jubilee	Orange Yellow	Yellow	Free	July 1-15	Excellent for table, market and canning	Good
Hiley	Creamy white Red cheek	White	Free	July 1-15	Excellent for market, table, canning	Excellent
Halehaven	Orange Yellow	Yellow	Free	July 5-20	Good for table, market, and canning	Excellent
Georgia Belle	Creamy white	White	Free	July 5-20	Excellent for table market, canning	Excellent
Early Elberta	Orange Yellow	Yellow	Free	July 10-25	Excellent for table, market, canning	Excellent
Elberta	Orange Yellow	Yellow	Free	July 15-30	Excellent for market, good canning	Good
J. H. Hale	Orange Yellow	Yellow	Free	July 15-30	Excellent for market, good canning	Fair to good
Indian Blood	Dull Red	Red	Cling	Aug. 1-15	Good for table and pickling	Good
Heath Cling	Creamy white	White	Cling	Aug. 15-30	Good for table and pickling	Good

Berries large, bright crimson, and of very good quality. It is an excellent home garden variety and gives high yields. Ripening date April 1-20.

Klonmore—Klonmore is a recent introduction of the Louisiana Experiment Station and originated as a cross between Klondike and Blakemore. The plants are resistant to leaf diseases, ripens fruit earlier than Klondike and less acid. The berry is of good dessert quality, firm, and light red in color. It appears best adapted to the southern part of the state and may replace the Klondike in this section as a commercial berry. Ripening date April 1-20.

Blakemore—A very productive variety. Plants strong, and produce runners so freely that they must be spaced for the production of large fruit. Foliage subject to leaf spot. Berries conic in shape, bright light red color, firm, and of good quality. It is considered to be one of the best preserving varieties. It is especially adapted to production in the central and northern parts of the state. Ripening date April 5-25.

Fairmore—The plants of Fairmore are large, vigorous, resistant to disease, make an ample number of runners, and produce good yields. The berries are very large, deep red, firm, and of excellent dessert quality. This variety is new but appears to be one of the very best for both home and commercial use. It is apparently best adapted to the central and northern parts of the state. Ripening date April 5-25.

Missionary—It is the commercial variety of Florida where it produces large, deep red, firm fruit of good quality. Plants vigorous, and produces runner plants freely. Foliage subject to scorch. Best adapted to the southern sections of the state and probably surpassed there by other varieties. Ripening date April 5-25.

Klondike—Plants are strong, productive, and produce runners freely, especially late in the season. Leaves subject to both scorch and spot, and frequently leaf scorch reduces the yields and kills the caps of the plants. Berries large, deep red, excellent quality but extremely acid. It is considered to be one of the best freezing varieties and has been the standard commercial variety for many years in Alabama, Louisiana, and Mississippi. Ripening date April 10-30.

ACKNOWLEDGMENT

The writer wishes to acknowledge his indebtedness and to express appreciation to all the members of the Experiment Station and Extension Staff who have assisted in any way in the preparation of this bulletin; especially to Mr. W. S. Anderson, Associate Horticulturist of the Experiment Station, for his suggestions and criticisms; and to Mr. N. H. Loomis, Junior Pomologist, U. S. Horticultural Field Station, Meridian, Mississippi, for his suggestion on that part of the bulletin pertaining to small fruits.

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BULLETIN No. 351 (Reprint of Edition of November 1940) JUNE 1942

PORK PRODUCTION

~~C-5845~~

Compiled by H. O. WEST, Research Coordinator

Jointly Representing Mississippi State Vocational Board
and : : Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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Pork Production

Compiled by H. O. WEST*

Pork is the most widely used meat in Mississippi, a great deal of which is imported. There is little doubt but that increased quantities of pork would be used if it were produced in the State.

According to the 1935 census, Mississippi had a total of 311,683 farms, of which total, 210,727 farms reported hogs on farms January 1. This leaves a total of 91,956 farms, or 29.5 percent of the farms in Mississippi without hogs. These figures will indicate that at least 29.5 percent of the Mississippi farms have a problem of supplying the needed pork for home consumption. Pork needed for home use can be obtained only by (1) purchasing the needed pork for home use which in some cases is not possible due to the low cash farm income and results in many families going without sufficient pork, or (2) producing the needed pork on the home farm.

At the present time, while cooperating under the Soil Conservation program many farmers are confronted with the problem of land utilization; that is, trying to use their land to the best advantage. Probably on most Mississippi farms, pork production for home use offers a profitable means to utilize sufficient cultivatable land to produce the necessary feed. In addition to producing pork for home use feed may be marketed profitably by producing hogs for the market to replace the enormous amount of pork that is imported in Mississippi.

In this compilation on "Pork Production," an attempt has been made to present information on the most important phases of producing pork. The information is divided into sections as follows: (1) Selecting hogs for pork production, (2) Diseases and parasites, (3) Houses and equipment, (4) Care, management and feeding of brood sows and pigs, (5) Feeding pigs through the fattening period, (6) Killing, curing and storing pork.

All the above points are considered important and in most cases essential in setting up a sucessful system of pork production It is hoped that the information presented in this compilation will be useful in making decisions on questions that are raised while considering and planning a system of pork production.

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*Jointly representing Mississippi Agricultural Experiment Station and Mississippi State Vocational Board.

PART I

Selecting Hogs for Pork Production

Selecting hogs for pork production should receive careful consideration. The kind of hogs used has a direct bearing on the success or failure of the enterprise.

There are two distinct types of hogs, represented by the breeds of the lard type and breeds of the bacon type. The lard type hogs are used much more extensively in the United States than the bacon type. Principal breeds of the lard type are: Duroc-Jersey, Poland China, Chester White, Berkshire, Hampshire, and Spotted Poland China. The bacon breeds are Tamworth and Yorkshire.

In selecting the type or breed of hogs, the fact should be considered that there is as much variation in type within a breed as there is between breeds. Therefore comparable representatives should be selected when a study of breed efficiency is made. In addition to considering the purebreds, consideration should be given to a comparison of crossbreds versus purebreds, also to inbreeding and outbreeding. All of these points should be considered in selecting breeding stock to be used for pork production.

General Characteristics of the Lard Type

Within the last 30 years rather drastic changes have been made in the appearance of the lard-type hog. Formerly it was a rather low-set, broad, blocky, type of animal. Today most lard-type hogs are upstanding, having good length and depth, with medium width. The shoulders should be full and smooth, not coarse; the hams full and as wide as the shoulders, carried back well to the root of the tail, and fleshed down to the hock. The flesh should be evenly distributed over the body.

Duroc-Jersey

The Duroc-Jersey breed originated in the northeastern section of the United States. It was derived from mating strains of red hogs developed in sections of New York and New Jersey. Those in New Jersey were originally called Jersey Reds; those in New York are said to have been developed by a man who owned a noted stallion named Duroc, and people in that vicinity called the red hogs, which this man was breeding "Duroc" hogs. Several years after the independent breeding of Duroc and Jersey Reds, these hogs were intermingled in breeding, with the result that there was formed the breed known at the present time as Duroc-Jersey. The present tendency seems to be toward use of the single word, "Duroc." This breed is red in color, without admixture of any other colors. The popular color is referred to as cherry red; some animals, however, are dark, while others are light. There is no recognizable difference in the feeding or other qualities among hogs of the different shade of color in this breed.

From its early history the Duroc-Jersey breed was noted for hardiness and prolificacy. It began to be popular in the United States about the time Poland China breeders were producing the small type of hogs or so-called "hot bloods." This popularity had much to do with making the Duroc-Jersey breed as widespread as it is today. Animals of this breed had sufficient quality and hardiness to make them profitable to hog growers. In type they are similar to big-type Poland Chinas. The older boars when in show condition do not as a rule acquire quite so much weight as those of the Poland China breed. The legs are of medium length, with good bone. The sows are prolific and are good milkers and mothers. Duroc-Jerseys are good grazers and are profitably adapted to following cattle in the feed lots

Pigs of the most desirable type attain a weight of 200 pounds at 6 months of age and are capable of producing a greater weight at a profit if market conditions justify their being fed for a longer time. Boars are massive and have good length and depth with good backs. In show condition they may attain a weight of 1,000 pounds. In breeding condition an aged boar generally weighs from 650 pounds up.

Duroc-Jersey sows generally are upstanding, having good depth with good backs as well as good feet and legs. One seldom finds a sow of this breed cross or fretful. In show condition sows generally weigh from 600 to 700 pounds. In some instances a greater weight is reached.

The association for recording hogs of this breed is the United Duroc Record Association, Peoria, Illinois.

Reference: Farmers' Bulletin 1263, "Breeds of Swine," pages 2, 3, and 4, United States Department of Agriculture, Washington, D. C.

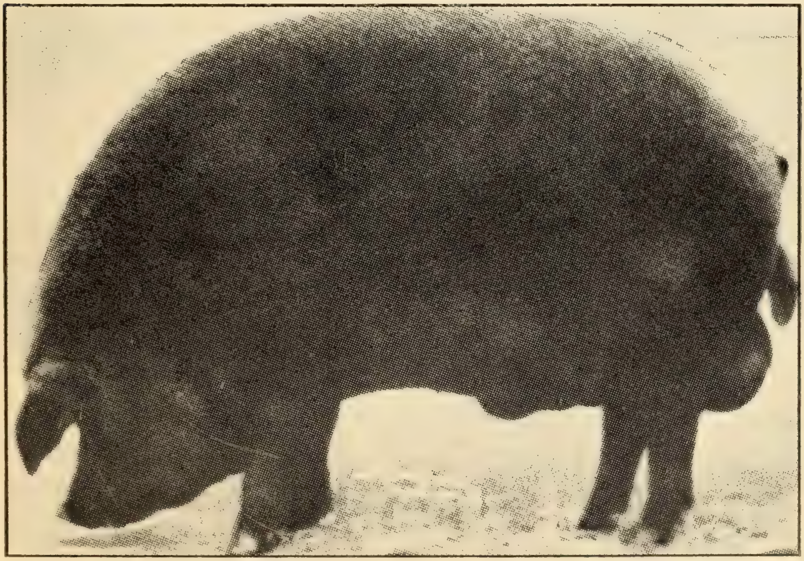

Figure 1. Duroc-Jersey Boar.

Poland China

The Poland China hog originated in Butler and Warren Counties, Ohio. This breed undoubtedly was derived from the crossing of several breeds. In the Seventies two farmers—A. C. Moore, of Canton, Ohio, and D. M. Magie, of Oxford, Ohio—developed a widespread reputation for their hogs and advertised them extensively. Their hogs were known at that time, respectively, as the Moore hogs and the Magie hogs. From the Moore and Magie hogs was developed the breed now known as the Poland China.

The early Poland China hog was a large, rugged, coarse-eared, heavy-boned, prolific, spotted animal that attained a good market weight but was not of the easiest feeding type. During the last decade of the nineteenth century and the first decade of the twentieth century many Poland China breeders, especially those breeding for the show ring, followed what may be termed a fad in their breeding operations. The fashionable type was a short-legged, small, compact-bodied hog popularly known as the "hot blood." It has six white points, namely, four white feet and a white splash on the end of the tail and at the point of the nose. The sows were neither prolific nor very good sucklers.

During the last 30 years the type of Poland China hog has been changed materially. On only very few farms can one find any of the old hot-blood Poland Chinas. On a large number of farms, however, Poland Chinas of what may be termed the "medium type" are produced. Many breeders of Poland Chinas still produce the large type, but not the extremely large type, which was popular among some breeders shortly after the close of the World War.

The boars have big, heavy bone, are rugged, possess plenty of length and depth, and with it all have good quality. Mature boars, of this type, in show condition weigh from 850 to 1,000 pounds. Some animals show greater weights. In breeding condition aged boars should weigh from 650 pounds up and sows from 500 pounds up. The sows are prolific, good sucklers, and are capable of raising good-sized litters. They have plenty of length, are smooth, with good, full shoulders and well-rounded hams. They are naturally active, take plenty of exercise, and are capable of producing strong litters at farrowing time. The color of the present-day Poland China generally is black. Many of them have white spots on different parts of the body.

The Poland China produces an excellent finished carcass at an early age. Hogs of this breed often weigh 200 pounds at 6 months of age.

There are three associations in the United States that register purebred Poland China hogs, namely: the American Poland China Record Association, Union Stock Yards, Chicago, Illinois; the Standard Poland China Record Association, Maryville, Missouri; and the National Poland China Record Association, Winchester, Indiana.

Reference: Farmers' Bulletin 1263, "Breeds of Swine," page 4, United States Department of Agriculture, Washington, D. C.

Berkshire

The Berkshire is one of the oldest of the improved breeds of swine. This breed originated in England and is still used extensively in that country. Many animals of this breed have been imported into the United States and Canada from English herds. Mention is made of the Berkshire hogs in England and Scotland as early as 1789, large specimens being compared with those of other breeds.

Berkshire hogs are found in noted herds in the United States. They are of medium size, generally smooth and of good length and depth, having legs of medium length with fair size. In color this breed is similar to the Poland China. The peculiarity of the Berkshire breed is the short, upturned nose. The face is usually dished and the ears are erect, but inclined slightly forward. Berkshire hogs have good width of body, the back is broad and the

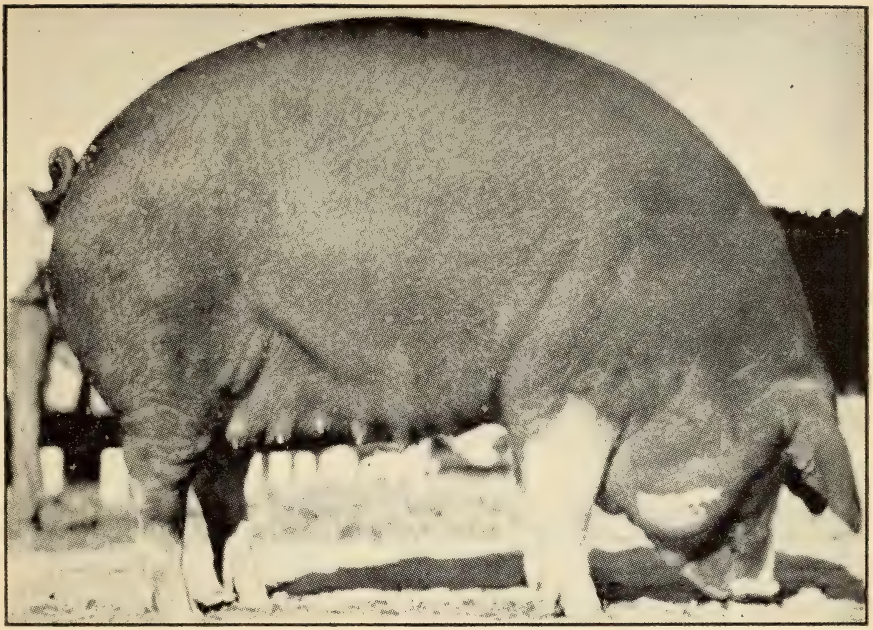

Figure 2. Poland China Sow.

ribs well sprung. The hams and shoulders are generally smooth and well fleshed. The meat of the Berkshire is smooth and well fleshed and is generally regarded as good in quality.

Berkshire pigs may be fed to market weight at around 6 months of age. Mature boars of this breed in show condition usually weigh from 600 to 850 pounds. Some attain a heavier weight. Mature sows should weigh from 450 to 650 pounds.

The record association for this breed is the American Berkshire Association, 508¼ East Monroe Street, Springfield, Illinois.

Reference: Farmers' Bulletin 1263, "Breeds of Swine," pages 7 and 8, United States Department of Agriculture, Washington, D. C.

Chester White

The Chester White originated in Chester County, Pennsylvania. The large, coarse hogs found in the Eastern States, especially in Pennsylvania, early in the nineteenth century were a mixture of the Yorkshire, Lincolnshire, and Cheshire hogs, all of which were of English origin. In Pennsylvania these large hogs were crossed on smaller type hogs, but the most successful cross was by using imported hogs from Bedfordshire, England. This crossing was continuously improved up to 1848, when the breed reached such a degree of purity that it could be relied on to reproduce its desirable qualities. It was named "Chester County White," in 1848, but the word "County" was soon dropped and the present name became established.

The first record association for the breed was formed in 1884, and to its records all individuals of the breed trace. Later there were eight different

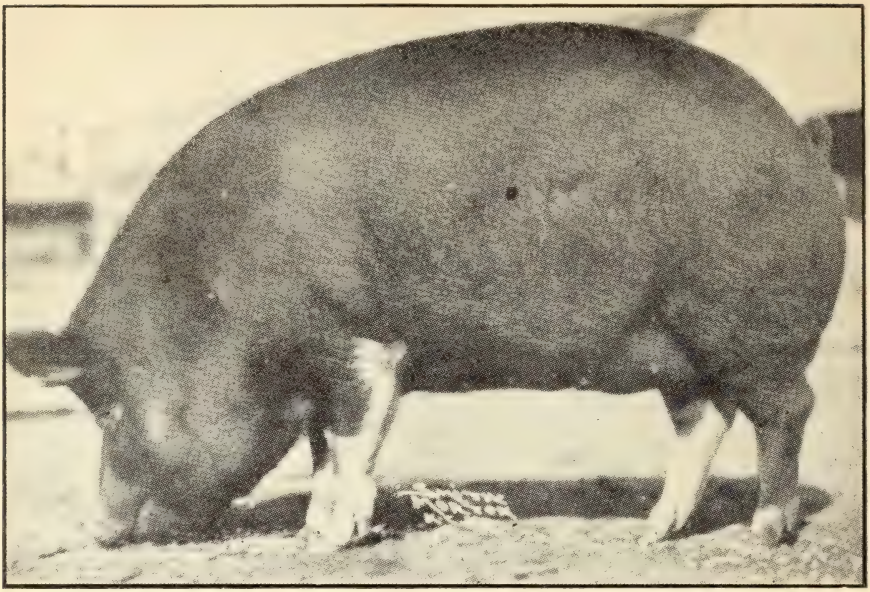

Figure 3. Berkshire Sow.

record associations catering to the business of the breed, and as these lessened the unity of action among the breed's advocates the popularity that the breed had acquired during the latter half of the nineteenth century seemed to wane, but in recent years it has regained its popularity.

The Chester White is a very prolific hog. It has a good disposition and easily adapts itself to its environment. It matures early, and, being a good grazer, a good feeder, and possessing good dressing qualities, has demonstrated its utility on many farms. From 1884 the uniformity of size for age of the Chester White has been commendable. The score-card type of the standard of excellence is very similar to the type of the other lard breeds of swine. Mature boars of this breed weigh from 600 to 900 pounds, some individuals showing a weight of 1,000 pounds. The sows weigh from 500 to 700 pounds.

The record associations for the breed are Chester White Record Association, Rochester, Ind.; the O.I.C. Swine Breeder's Association, Goshen, Ind.; and the Breeders' Chester White Record Association, 603 Third Street, Des Moines, Iowa.

Reference: Farmers' Bulletin 1263, "Breeds of Swine," pages 6 and 7, United States Department of Agriculture, Washington, D. C.

Hampshire

The Hampshire breed originated in the English county of the same name and was introduced into the United States during the first half of the last century. When the Hampshire hog first began to be popular in the United States it was often referred to as the "Thin Rind" hog and was classed as a bacon breed. It is now recognized as one of the lard breeds. Hampshires

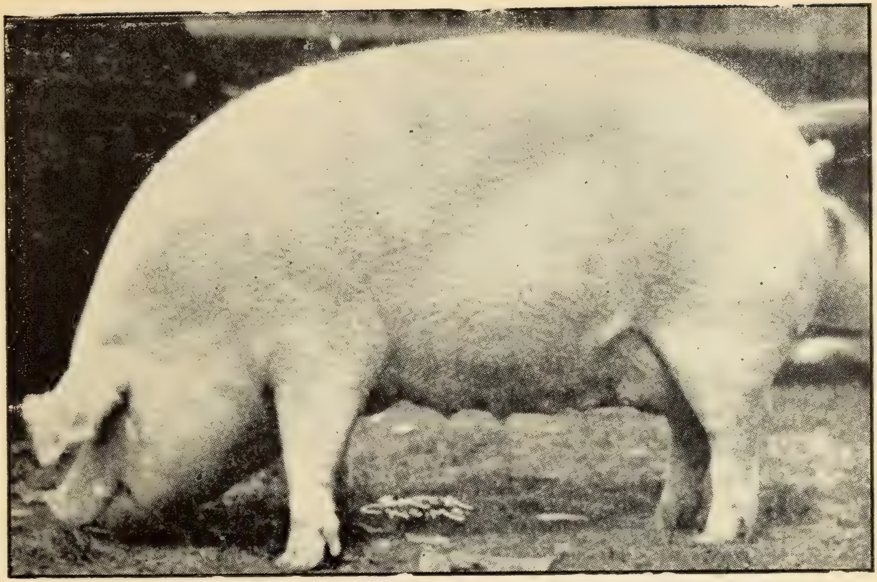

Figure 4. Chester White Sow.

have made rapid progress in popularity during the last 20 to 25 years. Sows of the breed are prolific. The mothers are good sucklers and make good use of grass in pasture.

The most striking characteristic of the Hampshire is the white belt around its body, including the shoulders and front legs. The standard of perfection for Hampshire looks with disfavor upon white showing high on the hind legs and on belts greater than one-fourth their body length. Hampshire breeders sometimes discard excellent animals in their breeding operations because of imperfect belts or because they have white hind feet or legs.

The Hampshire in general appearance is smooth and has legs with medium-sized bones. Hampshire breeders are making efforts to increase the size of the bone and the strength of the feet and legs. The body is often not so broad as that of typical hogs of the other lard breeds, but it is deep and smooth and produces desirable sides for bacon. The jowls are light, the head is small and narrow, the snout rather straight and of medium length, the ears erect, the shoulders smooth and well set, and the hams deep but usually not especially thick. The flesh is of good quality. Animals of this breed sell readily upon the open market.

The Hampshire possesses good growing and fattening qualities, and pigs may be brought to marketable weights at around 6 months of age. In show condition mature boars of the breed weigh from 600 to 850 pounds, some attaining a greater weight. Mature sows in show condition weigh from 500 to 700 pounds.

The record association for this breed is the Hampshire Swine Record Association, 915-917 Commercial Bank Building, Peoria, Illinois.

Reference: Farmers' Bulletin 1263, "Breeds of Swine," pages 9 and 10, United States Department of Agriculture, Washington, D. C.

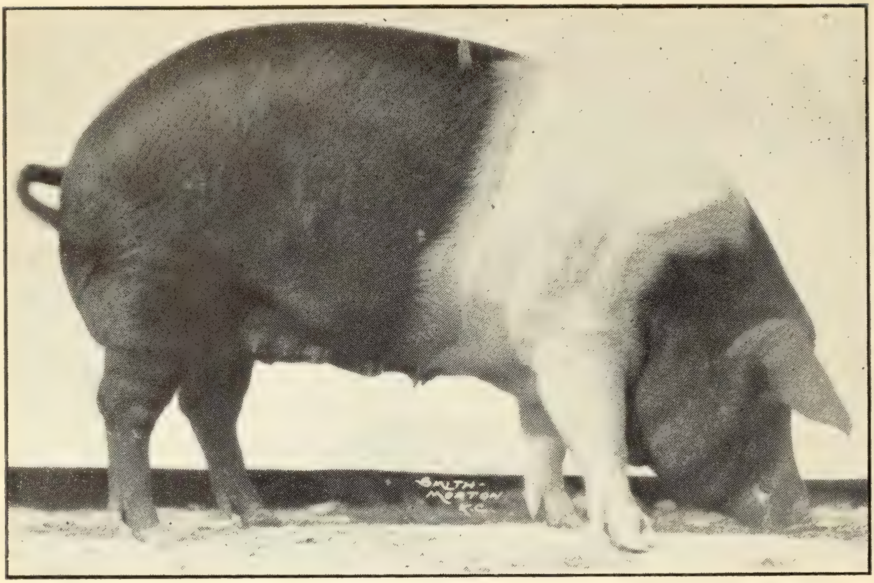

Figure 5. Hampshire Sow.

Spotted Poland China

The Spotted Poland China in many ways is similar to the Poland China, but there is much more white on the body of the former. The appearance is rather that of a black hog with numerous white spots. The standard requirement of the present record association for the breed is that at least 20 percent of the body be white. These hogs began to be noticed more during the time when there was a tendency throughout the country to get away from the hot-blood Poland Chinas. The Spotted Poland China hog, having more length and greater size than the hot-bloods attracted the attention of farmers who were looking for larger hogs. The first record association of this breed, known as the National Spotted Poland China Record Association, was organized January 1, 1914.

The general type found in this breed is a hog with good length, fairly straight, broad back, good depth of body, legs of medium length with heavy bone of medium quality. The head is short and broad, and the ears are somewhat larger than those of the Poland China breed. Some Glouster Old Spots, imported from England into the United States as foundation animals in some herds and recorded in the Spotted Poland China Record, have influenced the type in this breed to a considerable extent. Boars in show condition weigh from 650 to 1,000 pounds, and sows from 500 to 700 pounds. The sows are prolific and raise good-sized litters

The present record associations for this breed are the National Spotted Poland China Record Association, Bainbridge, Ind.; and the American Spotted Poland China Record Association, Moberly, Missouri.

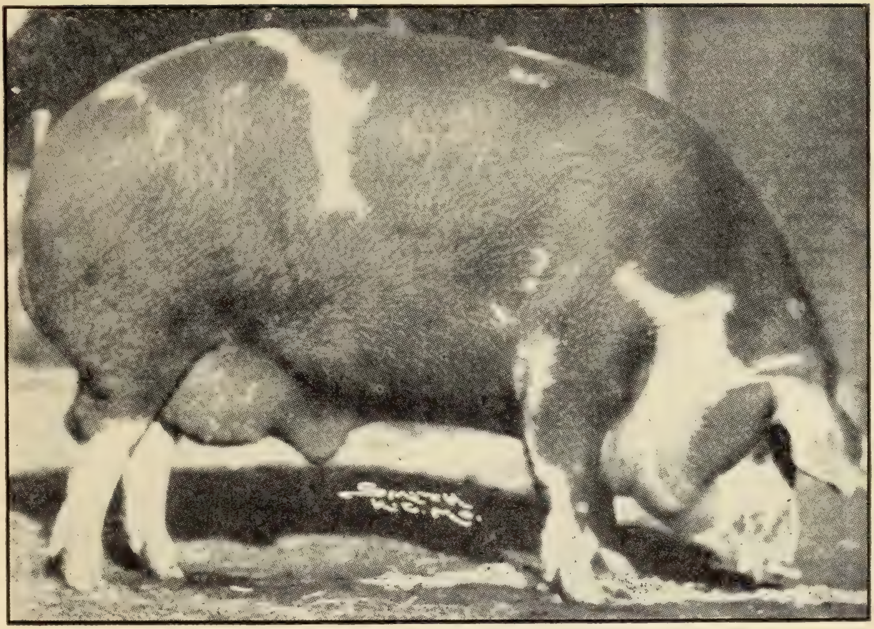

Figure 6. Spotted Poland China.

Bacon Type Breeds

Hog growers in the United States do not raise the bacon-type hog to any great extent, probably because of the fattening feeds commonly used, such as corn, peanuts, and sweet potatoes. The Tamworth and the Yorkshire, of English origin, are the two breeds grown in the United States which represent this type. The Tamworth breed is established in many localities over a wider area. The Yorkshire is confined principally to the Northern States.

Bacon hogs are different from lard-type hogs in that they have extreme length, the object of breeders being to produce the maximum amount of bacon with relatively small hams and shoulders. Animals of this type have good depth, deep sides, and are comparatively narrow, with generally smoother bodies than most of the hogs of the lard breeds.

Tamworth: The Tamworth is one of the oldest and probably one of the purest of all breeds of hogs. There is no evidence of its having been crossed with other modern breeds. On the other hand, there is evidence of pure breeding dating back more than 100 years. The name of the breed is derived from the town of Tamworth, located on the River Thames, in Staffordshire, near the north border of Warwickshire, England. Sir Robert Peel is credited with having introduced these hogs into England from Ireland about 1812, although their real origin is obscure. The first record of any of this breed having been brought to the United States appears to have been in 1881.

Hogs of the Tamworth breed are rather long-legged, with long, deep, smooth bodies, strong backs, narrow heads, rather long snouts, and fairly

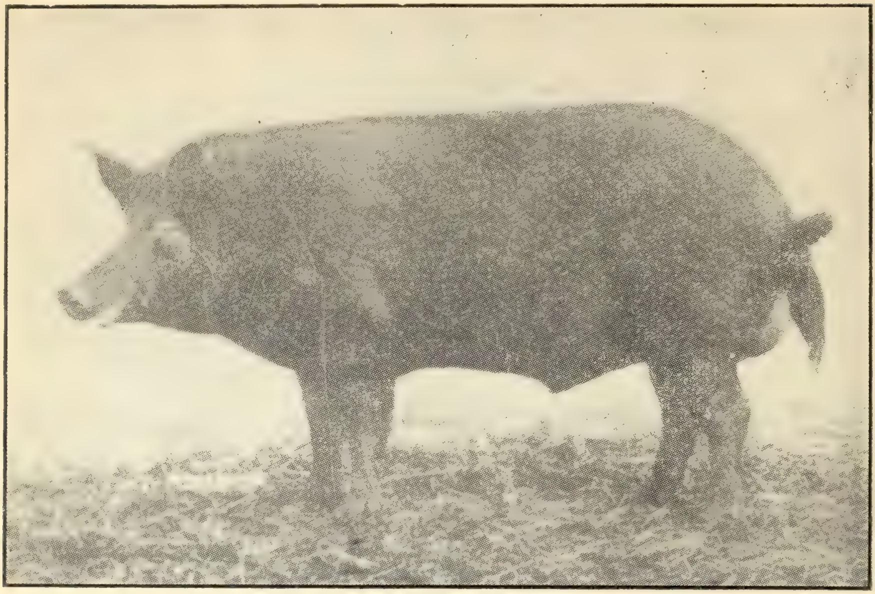

Figure 7. Tamworth

large ears, usually erect and often inclined forward. The jowls are light, and the bone is medium in size but generally of very good quality. The color is red, varying from light to dark. These hogs are good grazers and take on flesh readily. Pigs of 200 pounds weight at 6 months of age are not uncommon. They do not finish quite so early as some of the lard type. At the same time, they attain a market weight at as early age as any of the lard type breeds and can be fed profitably to great weight. Mature boars weigh from 700 to 1,000 pounds. Mature sows weigh from 550 to 800 pounds. The sows are prolific and generally good sucklers

The record association for this breed is the Tamworth Swine Association, Ames, Iowa.

Yorkshire

There are two distinct types of the Yorkshire breed, known as Large and Middle Yorkshires. Both originated in England, where they are known as Large and Middle Whites. The large Yorkshire greatly out-numbers the other and is the type raised by Yorkshire breeders in the United States.

They are large, white hogs with smooth, even, deep bodies, very long, capable of dressing out a large percentage of meat with bacon of very good quality. The body is supported by legs of good length, having bone of medium size and generally of very good quality. Occasionally there are black pigment spots in the skin of animals of this breed. This does not disqualify them, yet it is objectionable from the standpoint of breeders of purebred stock. Large Yorkshire sows are prolific and are generally very good sucklers. Mature boars of this breed weigh from 700 to 1,000 pounds. Mature sows should weigh from 500 to 800 pounds.

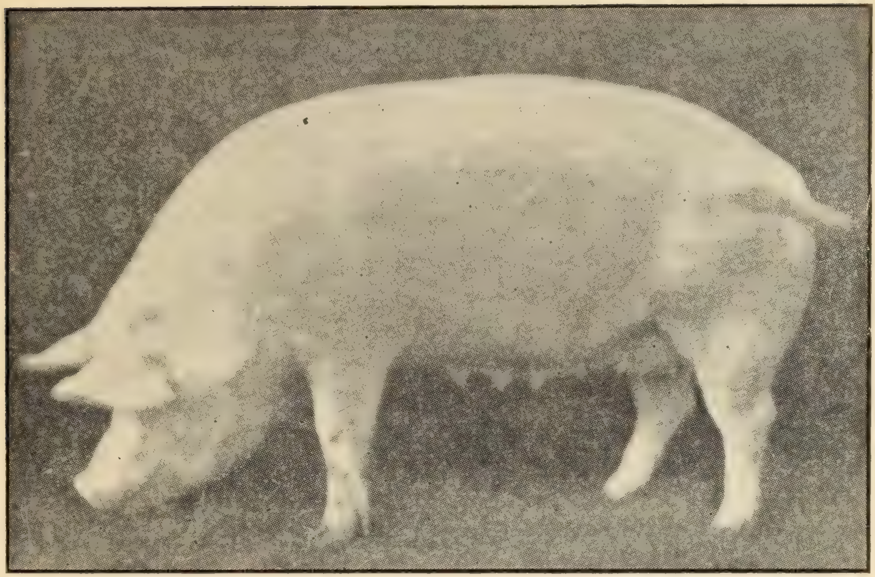

Figure 8. Yorkshire

The American Yorkshire Club, 1001 Lafond Street, St. Paul, Minn., is the recording association for this breed.

Reference: Farmers Bulletin 1263, "Breeds of Swine," Department of Agriculture, Washington, D. C.

CROSSBREEDING HOGS FOR PORK PRODUCTION IN IOWA

Conducted by: Iowa Agricultural Experiment Station.

Conducted at: Ames, Iowa.

Period: 1926-1933, 8 years.

Purpose: To determine the value of crossbreeding hogs for pork production.

Procedure and Conditions:

Animals Used: 1926—Six Poland China sows were "double-mated" to a purbred Poland China and a purebred Duroc-Jersev boar in the same heat period. This type of mating was used in order to produce both purebred and crossbred pigs in the same litter, thus reducing to a minimum the effect of the differences between sows as dams of the two kinds of pigs. The purebred and crossbred pigs from this sort of mating are easily identified by their color markings because the crossbred pigs are light red or sandy with numerous black spots.

1927—Six Poland China sows are double-mated to a Poland China and a Duroc-Jersey boar. In addition, three of the crossbred gilts saved from the litters farrowed in the previous year's work were mated to the Poland China boar and three other crossbred gilts from the same source were mated to the Duroc-Jersey boar. One of the gilts of the latter group did not settle to the first service of the Duroc-Jersey boar and was not continued in the experiment.

1928—Five purebred Duroc-Jersey gilts were used instead of the Poland Chinas. Instead of the crossbred gilts used in the 1927 work, three of the three-quarter Poland China (one-quarter Duroc-Jersey) gilts farrowed in the spring of that year were mated to the purebred Poland China boar, and three of the three-quarter Duroc-Jersey (one-quarter Poland China) gilts were mated to the purebred Duroc-Jersey boar. This was done to find whether these backcross gilts had all or part of the hybrid vigor that was shown by the first-cross gilts. Some of the "seven-eighths blood" gilts from these litters were saved for further "grading up" the next year.

1929—Five purebred Duroc-Jersey sows were used, along with the high grade gilts. Two of the purebred sows were removed from the experiment, one because of death and one because of a retained placenta. The three remaining purebred sows farrowed only three crossbred pigs, only two of which reached weaning age. Consequently there are practically no data on crossbred pigs for that year.

1930—The high-grade gilts from the 1929 grade litter were saved and used as breeding stock. These gilts were fifteen-sixteenths pure Poland China or Duroc-Jersey, and both kinds were double-mated to boars to both breeds to produce the crossbred and near purebred pigs for comparison.

1931—A new cross was introduced to determine whether the hybrid vigor observed in the crossbred animals was changed by further out-crossing. A Yorkshire boar, a Duroc-Jersey boar and a Poland China boar were used in various combinations with the Duroc-Jersey and the Poland China sows and with the Poland China-Duroc crossbred sows. The Yorkshire boar was single-mated to one of the Poland China sows as a test mating to determine whether he was pure (homozygous) for the white color. If this mating had produced any pigs which were not white it would have invalidated the double-matings in which the Yorkshire boar was used, because the Yorkshire crossbreds might not be distinguished from their purebred litter mates. Such double matings were made by using the Yorkshire and the Poland China boar on three crossbred Poland China-Duroc sows, and on a high grade Poland China sow. The Yorkshire boar was also used with a Duroc boar in double-matings with three almost purebred Duroc-Jersey gilts.

1932-1933—In 1932 and 1933, the Yorkshire crossbreeding was continued much the same as in 1931, except that only the Yorkshire and the Poland China boars were used. In these years the pigs were fed to 225 pounds in the Swine Record of Performance experiment and not a a separate part of the crossbreeding experiment.

Quarters: From 1926 through 1931 the pigs were fed out on bluegrass pasture. During 1932 and 1933 pigs were kept in small dry lots with concrete floors.

Rations: 1926 through 1931

Shelled corn, self-fed
Supplemental mixture, self-fed
  Tankage 50 percent
  Corn oil meal 25 percent
  Alfalfa meal 25 percent
Mineral mixture, self-fed
  Common salt 19.99 percent
  Wood ashes 39.98 percent
  Bone black 39.98 percent
  Potassium iodide .05 percent

Rations: 1932 and 1933

Shelled corn, self-fed
Supplemental mixture, self-fed
  Tankage 50 percent
  Linseed oil meal 25 percent
  Alfalfa meal 25 percent
Mineral mixture, self-fed
  Ground limestone 50.00 percent
  Special bonemeal 27.97 percent
  Common salt 20.00 percent
  Iron oxide 2.00 percent
  Copper sulphate .01 percent
  Potassium iodide .02 percent

Year	No. sows used	Breeding of sows	Type of breeding (double or single)	Breeding of sire or sires	Breeding of pigs	Pigs farrowed		Pigs weaned		Pigs fed to 225 pounds		
						Total no. farrowed	Av. birth Wt.	No. weaned at 60 days	Av. weaning Wt.	No. fed	Av. daily gain in pounds	Lbs. of feed per 100 lbs. gain
1926	6	Poland China	double	Poland & Duroc	Litter purebred Poland China	23	2.85	13	36.3	13	1.33	343
					mates crossbred Poland-Duroc	38	2.77	27	37.3	13	1.43	325
1927	6	Poland China	double	Poland & Duroc	Litter purebred Poland China	35	2.90	21	37.7	19	1.30	406
					mates crossbred Poland-Duroc	26	2.74	15	43.3	15	1.36	358
	2	Poland x Duroc	single	Duroc	¾ Poland	31	2.84	26	27.3	24	1.15	411
	3	Poland x Duroc	single	Poland	¾ Duroc	19	2.90	19	32.6	19	1.20	370
1928	5	Duroc-Jersey	double	Poland & Duroc	Litter purebred Duroc-Jersey	11	2.91	7	33.3	7	1.31	316
					mates crossbred Poland China	37	3.56	28	33.7	7	1.35	322
	3	¾ Duroc-Jersey	single	Duroc	⅞ Poland	16	3.39	13	42.2	11	1.31	401
	3	¾ Poland China	single	Poland	⅞ Duroc	25	2.81	18	34.0	18	1.29	364
1929	5	Duroc-Jersey	double	Poland & Duroc	Litter purebred Duroc-Jersey	56	3.00	22	35.3	7	1.03	432
					mates crossbred Poland China	6	3.43	2	35.3	0		
	2	⅞ Duroc-Jersey	single	Duroc	15/16 Poland	22	2.89	14	38.6	9	1.24	407
	3	⅞ Poland China	single	Poland	15/16 Duroc	21	2.44	17	39.1	12	1.07	398
1930	3	15/16 Poland China	double	Poland & Duroc	Litter purebred Poland China	3	2.67	3	26.7	0	....	..
					mates crossbred Poland-Duroc	25	3.05	19	37.1	12	1.44	327
	3	15/16 Duroc-Jersey	double	Poland & Duroc	Litter purebred Duroc-Jersey	26	3.16	20	32.4	9	1.44	316
					mates crossbred Poland-Duroc	6	3.73	6	47.8	6	1.58	308
1931	1	Poland China*	single	Yorkshire	Litter purebred Poland China	3	2.77	3	27.3	0		...
					mates crossbred Poland-Yorkshire	8	2.82	7	28.4	0		
	3	Poland x Duroc	double	Yorkshire & Poland	crossbred Poland-Yorkshire	10	2.66	8	41.4	0	..	..
	3	Duroc-Jersey*	double	Yorkshire & Duroc	Litter ¾ Poland China	13	2.90	11	34.7	9	1.46	290
					mates three breed crossbreds	15	2.83	15	32.3	8	1.39	370
	1	Poland China*	double	Yorkshire & Poland	Litter purebred Duroc-Jersey	11	2.78	8	37.1	7	1.46	349
					mates crossbred Duroc-Yorkshire	15	2.67	12	36.1	8	1.27	341
1932	5	Poland x Duroc	double	Yorkshire x Poland	Litter ¾ Poland China	14	2.87	12	39.0	0	....	..
					mates three-breed crossbreds	36	3.10	33	37.7	4	1.73	334
	6	Poland China*	double	Yorkshire & Poland	crossbred Poland-Yorkshire	43	3.13	40	43.7	4	1.64	346
1933	5	Poland x Duroc	double	Yorkshire & Poland	Litter purebred Poland China	6	2.45	3	22.3	0	...	
					mates crossbred Poland-Yorkshire	27	2.80	20	44.8	4	1.41	373
	3	Poland China*	double	Yorkshire	Litter ¾ Poland China	8	3.02	8	49.2	4	1.35	394
					mates three-breed crossbreds	55	2.85	38	45.8	4	1.62	346
All years					ALL BREEDS	690	2.95	509	37.6	253	1.32	364

*Very high grade (.97 or more, purebred)

Results:

COMPARISON OF CROSSBRED AND PUREBRED BROOD SOWS

	Crossbred sows	Purebred sows	Advantage for crossbreds
Total litters farrowed	18	20	—
Total number of pigs farrowed	191.00	184.00	—
Average size of litter	10.60	9.20	1.40
Average birth weight of litter	30.90	26.20	4.70
Average birth weight of pigs	2.91	2.85	.06
Total pigs weaned	162.00	137.00	—
Average number of pigs weaned per litter	9.00	6.85	2.15
Average weaning weight of litter	339.00	275.00	64.00
Average weaning weight of pigs	37.70	40.10	—2.40
Percentage of pigs farrowed that lived to weaning	85.00	74.00	11.00

Of the 20 purebred sows used, 3 were Duroc-Jerseys and 17 Poland China.

Reference: Iowa Agricultural Experiment Station Bulletin 380, "Crossbreeding Hogs for Pork Production," pages 86, 87, 88, 89, and 97, tables 1, 2 and 3, Ames, Iowa, June 1939.

A Comparison of Crossbred and Purebred Pigs as to Rate and Economy of Gains

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Coast Station, Summerville, South Carolina.

Period: 2 years, 1936-1938.

Purpose: To compare crossbred and purebred pigs as to rate and economy of gain.

Procedure and Conditions: Beginning with the fall of 1936 and through the fall of 1938, 19 purebred Poland China sows were double-mated to a purebred Poland China and a purebred Duroc-Jersey boar, the interval between the services of the boars being only a few minutes. As a result of these 19 double-matings, six purebred litters, three crossbred litters, and 10 mixed litters composed of both purebred and crossbred pigs were farrowed. Of the 10 mixed litters, 39 pigs, or 40.625 percent, were crossbreds and 57 pigs, or 59.375 percent, were purebreds. Birth weights obtained on 17 crossbred pigs showed an average weight of 2.52 pounds, while that of 41 purebreds was 2.27 pounds. The average weaning weight obtained on 15 crossbreds was 49.95 pounds, while that of 23 purebreds was 41.71 pounds.

The rate and economy of gains of both purebred and crossbreds from mixed litters is given in the following table.

Results:

RATE AND ECONOMY OF GAINS OF CROSSBRED VERSUS PUREBRED HOGS

	Crossbreds	Purebreds
Number of pigs	23.000	25.000
Average initial weight	58.830	58.760
Average daily gain	1.846	1.664
Feed consumed per 100 lbs. gain		
Corn (pounds)	288.000	310.000
Fish meal (pounds	21.000	19.570

Reference: South Carolina Agricultural Experiment Station Fifty-second Annual Report, pages 101 and 102, table 34, Clemson, South Carolina, December 1939.

Purebred Versus Crossbred Pigs

Conducted by: Nevada Agricultural Experiment Station.

Conducted at: Reno, Nevada.

Period: 1938-1939.

Purpose: To determine the difference in the rate of growth and in economy of gains of purebred versus crossbred pigs.

Procedure and Conditions: In these tests purebred Duroc and crossbred Duroc-Poland China pigs were used. In all the experiments the method of feeding was essentially the same. Each pig received daily four pounds of skim milk and one-fourth pound of a mixture containing four parts fish meal and three parts linseed oil meal. In summer they grazed on alfalfa pasture and in winter three parts of alfalfa meal were added to the protein mixture given above.

In addition barley was fed in amounts based on the weight of pigs as shown in the table below. Pigs were weighed every two weeks and the barley ration was adjusted to the individual weight. Experiments were discontinued when an average weight of 200 pounds was obtained.

AMOUNT OF BARLEY FED DAILY TO PIGS OF DIFFERENT WEIGHTS

Weight of pig	Barley per day	Weight of pig	Barley per day
Lbs.	Lbs.	Lbs.	Lbs.
30	1.2	100	3.8
35	1.4	110	4.1
40	1.6	120	4.4
45	1.8	130	4.7
50	2.0	140	5.0
55	2.2	150	5.2
60	2.4	160	5.4
65	2.6	170	5.6
70	2.8	180	5.8
75	3.0	190	6.0
80	3.2	200	6.2
90	3.5	—	—

This series of tests included individual feed and group feeding. In the individual feeding experiments each pig was fed separately and in the 1938-39 individual feeding experiment alfalfa pasture was not available, therefore, alfalfa meal was included with the protein supplement. In the group-feeding experiment all pigs were fed together, the purebred and crossbred being kept separate. The amount of feed given was determined by the average weight of the group.

Results: CROSSBRED VERSUS PUREBRED PIGS

	Individual feeding				Group feeding	
	Summer 1938		Winter 1938-39		Summers 1938, 1939	
	Crossbred pigs	Purebred pigs	Crossbred pigs	Purebred pigs	Crossbred pigs	Purebred pigs
Number of pigs	6	6	6	6	10	10
Experiment began	May 24	May 24	Nov. 16	Nov. 16	May 21	May 21
Experiment ended	Sept. 16	Sept. 21	Mar. 1	Mar. 10	Sept. 1	Sept. 10
Days on experiment	115	120	105	114	105	112
Days per 100 lbs. gain	69	73	70	78	66	70
Initial weight (lbs.)	36	36	51	54	45	49
Final weight (lbs.)	202	201	201	201	202	203
Gain in weight (lbs.)	166	165	150	147	158	156
Daily gain (lbs.)	1.44	1.38	1.43	1.29	1.48	1.41
Daily gain (%)	1.52	1.44	1.35	1.31	1.43	1.38
Barley fed (lbs.)	432	447	413	453	406	441
Barley per 100 lbs. gain (lbs.)	260	271	275	308	257	276
Fish meal fed (lbs.)	16	17	11	11	15	16
Fish meal per 100 lbs. gain (lbs.)	10	10	7	7	10	10
Linseed oil meal fed (lbs.)	12	13	8	9	11	12
Linseed oil meal per 100 lbs. gain (lbs.)	7	8	5	6	7	7
Skim milk fed (lbs.)	460	480	419	455	420	448
Skim milk fed per 100 lbs. gain (lbs.)	277	291	279	310	265	282
Alfalfa meal (lbs.)	—	—	8	9	—	—
Alfalfa meal per 100 lbs. gain (lbs.)	—	—	5	6	—	—

References: Nevada Agricultural Experiment Station Bulletin 153, "Purebred and Crossbred Pigs, Comparison of Rate of Growth and Economy of Gains," pages 3, 4, 5, 6 and 7, tables 3 and 4, Reno, Nevada, June 1940.

INBREEDING AND OUTBREEDING OF SWINE

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 12 years, 1925-1936.

Purpose: To determine the effect of continuous inbreeding as compared with outbreeding of sows.

Procedure and Conditions: The foundation stock for this study was obtained late in 1923 from the herd of Durocs maintained by the college. Three sows were selected and mated to the boar, Peerless Sensation V. Inbreeding of foundation animals was negligible, based on 5 generation pedigrees.

It was not always possible to make half-brother and half-sister matings, and boars were not always of the same generation as the sow, which resulted in sometimes hastening and sometimes slowing down the rate of inbreeding, but it was a continuous procedure of limited inbreeding. The outbreed group was always mated with a male or female that was not related in anyway.

The breeding stock for the inbred and outbred group was fed and housed under identically similar conditions. The pigs were farrowed in a central barn and moved to small houses at about one week of age, in yards with green pasture (rye, oats, wheat, sudan, or rape). A creep in each lot or pen was provided with feed so that the pigs could begin eating at any time after one week of age. The pigs were weaned at 60 days of age and transferred to self-feeders supplied with shelled corn (yellow); wheat shorts, tankage (60 percent protein); and a mineral mixture consisting of: bonemeal, 38 parts; calcium carbonate, 39 parts; sodium chloride, 20 parts; ferrous sulphate, 2.5 parts; copper sulphate, 0.25 parts; and potassium iodide, 0.03 parts. Each litter was lotted separately throughout the fattening period insofar as possible; and when this procedure was not possible, the inbreds were fed as one group and the outbreds as another. When green pasture was not available, alfalfa meal was supplied at the rate of 5 pounds for each 100 pounds of feed. The pigs were fed to a weight of 225 pounds.

Results: AVERAGE SIZE OF LITTERS FARROWED

Generation of inbreeding*	Inbred			Outbred		
	Number of litters	Total pigs	Live pigs	Number of litters	Total pigs	Live pigs
1	12	8.9	7.8	10	9.4	8.3
2	4	7.5	6.8	10	9.2	8.7
3	15	7.1	5.9	10	8.5	8.1
4	28	7.1	6.3	10	9.1	8.4
5	21	6.4	5.7	10	8.9	7.1
6	26	5.5	4.7	10	10.4	8.4
7	13	6.0	5.6	10	9.6	9.1
8	7	5.3	5.1	5	10.0	9.4
Average	—	6.6	5.8	—	9.3	8.4

*The generations of inbreeding and years did not coincide, so that the pigs in one generation were raised in several different years. This helped to lessen the variation between generations which was caused by environment.

AVERAGE BIRTH WEIGHT OF LIVEBORN PIGS FOR EACH GENERATION OF INBREEDING

Generation of inbreeding	Inbred line		Outbred line
	Average percent inbreeding	Average birth weight pounds	Average birth weight pounds
1	15.6	2.28	2.59
2	20.5	2.36	2.75
3	31.2	2.26	2.55
4	34.6	2.06	2.54
5	39.3	2.13	2.31
6	42.4	1.89	2.21
7	42.4	2.04	2.62
8	45.6	2.25	2.27
Average	—	2.13	2.47

NUMBER AND WEIGHT OF PIGS WEANED DURING EACH GENERATION OF INBREEDING

Generation of inbreeding	Number of pigs	Average number per litter	Average weaning	Percentage of pigs surviving to weaning
1	71	5.9	26.1	76.3
2	17	4.3	25.0	63.0
3	44	2.9	24.4	50.0
4	97	3.5	21.2	56.4
5	56	2.8	23.8	49.1
6	59	2.3	25.3	52.2
7	38	2.2	24.4	45.8
8	16	2.3	24.3	44.4
Average for inbreds*	398	3.1	23.8	54.8
Average for outbreds	404	5.4	26.7	64.2

*Based on total of 129 litters.

THE AVERAGE DAILY GAINS FOR SPECIFIC PERIODS FOR EACH GENERATION OF INBREEDINGS

Generation of inbreeding	Birth to 60 days		61 to 120 days		121 to 180 days		181 days to 225 lbs.	Birth to 225 lbs. weight
	Number of pigs	Average daily gain lbs.	Number of pigs	Average daily gain lbs.	Number of pigs	Average daily gain lbs.		
1	71	0.40	29	0.55	26	0.70	1.36	0.84
2	17	0.38	11	0.28	13	0.48	1.04	0.68
3	44	0.37	31	0.34	26	0.60	1.02	0.68
4	97	0.31	69	0.39	63	0.64	1.14	0.71
5	56	0.36	53	0 45	43	0.84	1.14	0.76
6	54	0.38	47	0.43	39	0.83	1.27	0.81
7	30	0.38	22	0.45	20	0.77	1.23	0.78
8	12	0.32	11	0.38	9	0.85	1.02	0.74
Av. for inbreds	381	0.36	271	0.45	235	0.72	1.15	0.77
Av. for outbreds	404	0.40	338	0.54	317	1.05	1.27	0.85

AMOUNT OF FEED (IN POUNDS) REQUIRED TO PRODUCE 100 POUNDS GAIN BY INBREDS AND OUTBREDS

Year	Inbreds						Outbreds				
	No. pigs finished	In-breed-ing	Per 100 lbs. gain				No. pigs finished	Per 100 lbs. gain			
			Corn	Sh'rts	Tkg.	Total		Corn	Sh'rts	Tkg.	Total
1925	18	0.1464	246.8	149.8	20.9	417.5	No record				
1926	5	0.1430	240.3	164.1	27.4	431.9	16	——	——	—	412.4
1927	6	0.1854	289.9	155.9	29.8	475.6	16	——	——	—	414.9
1928	16	0.2549	299.1	160.6	24.7	484.4	29	——	——	—	469.0
1929	5	0.3098	296.9	154.8	31.9	483.6	7	304.3	130.5	18.3	453.1
1930	38	0.3464	292.2	133.1	24.4	449.7	7	211.9	141.7	24.9	378.5
1931	22	0.3484	283.8	132.3	24.3	440.4	41	260.9	112.4	18.0	391.3
1932	12	0.3974	293.1	132.6	26.3	452.0	48	306.1	96.3	21.9	424.3
1933	30	0.3963	261.3	100.1	19.4	380.8	43	269.4	94.4	19.9	383.7
1934	14	0.4006	240.3	80.1	21.7	342.1	18	255.6	85.1	21.3	362.0
1935	28	0.4057	344.4	71.8	17.9	434.1	27	304.6	61.9	15.1	381.6
1936	24	0.4206	295.8	109.0	26.1	430.9	18	300.8	108.1	26.1	435.0
Av.*	218	——	286.5	119.8	23.1	429.4	209	281.5	97.3	20.1	398.9
							270**	—	—	—	408.2**

*Average of feed per 100 pounds gain from 1929 to 1936 inclusive.

**Average total feed per 100 pounds gain from 1926 to 1936 inclusive.

COMPARISON OF INBRED AND OUTBRED BOARS WHEN MATED TO THE SAME OUTBRED SOWS

Boars Compared	Sows	Litters	Average no. pigs farrowed per litter	Average birth weight (lbs.)	Average no. weaned per litter	Average weaning weight (lbs.)	Average daily gains (lbs.)			Average no. days to 225 lbs.
							1st 60	2nd 60	3rd 60	
51A$_4$*	4	8	10.0	2.32	5.0	26.4	0.38	0.44	0.76	300
Miracle King	4	4	11.2	2.17	5.2	28.2	0.39	0.49	1.35	224
751A$_8$*	1	2	11.0	1.83	3.5	18.7	0.28	0.28	0.83	306
Miracle King	1	1	11.0	2.60	5.0	34.0	0.52	0.57	1.41	224
792B$_4$*	1	2	10.5	1.94	5.5	27.7	0.42	0.60	1.27	246
Miracle King	1	1	11.0	2.60	5.0	34.0	0.52	0.57	1.41	224
51A$_4$*	4	5	10.8	2.47	5.6	24.9	0.33	0.49	0.81	276
Wavemaster Stilts	4	4	10.2	2.19	7.5	25.9	0.39	0.71	1.42	229
792B$_4$*	3	4	7.3	2.56	6.5	25.6	0.39	0.55	1.17	256
Helendale Lad	3	3	9.3	2.48	8.0	23.1	0.34	0.62	1.28	241

*Inbred Boars.

Reference: Oklahoma Agricultural Experiment Station Technical Bulletin 7, "An Experimental Study of Inbreeding and Outbreeding Swine," pages 12, 15, 17, 18, 19, 26, and 32, tables 2, 3, 4, 5, 6, 7 and 16, Stillwater, Oklahoma, September 1939.

GRADING UP HOGS BY THE USE OF PUREBRED SIRES

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 5 years, 1924-28. This test started in 1924 but the results are given only for 1927-28 for the entire series of tests with all crosses.

Purpose: To secure definite data on the economic benefits derived from grading up native sows with purebred boars.

Procedure and Conditions:

Breeding Animals: The scrub litters used in this experiment were progeny of three different scrub sows and two different scrub boars of unknown breeding. The 50 percent purebred litters were out of two different sows and by the same boar. The 75 percent purebred litters were from the same sow and boar, and the 87.5 percent purebred litters were from the same sow and boar. All the female breeding animals used, with the exception of the three scrub sows, were raised on the Experiment Station Farm. Duroc, Poland China, and scrub boars were used in the experiment.

Lots: Sows had the run of a permanent pasture composed of Bermuda grass and lespedeza during the gestation period. A few days before farrowing they were placed in individual lots where they remained during the suckling period. When weaned, each litter of pigs was placed in a separate lot where they remained during the feeding test. Each lot was approximately 12 x 40 feet and contained a covered concrete floor at one end which served as a feeding floor and as a shelter for the pigs during bad weather.

Feeds Used: Sows received a grain mixture during the gestation and suckling period composed of 8 parts white corn, 4 parts wheat shorts, and 1 part tankage. Immediately after wearning, pigs were placed on a fattening ration consisting of 8 parts yellow corn, 4 parts wheat shorts, and 1 part tankage, plus a mineral mixture of equal parts by weight of charcoal, marble dust, and salt. The grain mixture and the mineral mixture were supplied separately in open troughs and kept before the animals at all times.

Weights: Pigs were weighed individually at the beginning and at the close of the experiment and each 28 days during the experiment.

Results:

GRADING UP HOGS BY USE OF PUREBRED SIRES

	Fattening scrub pigs			Fattening 1st cross (50% purebred) pigs			Fattening 2nd cross (75% purebred) pigs			Fattening 3rd cross (87½% purebred) pigs		
Season litter was produced	Fall 1927	Spring 1928	Spring 1928	Spring 1927	Spring 1928	Fall 1928	Spring 1927	Fall 1927	Spring 1928	Spring 1927	Spring 1928	Fall 1928
No. pigs farrowed	7	6	6	6	7	7	9	8	7	7	4	6
No. pigs raised and fed	5	6	5	5	4	6	9	7	6	7	4	6
	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days
Age weaned placed on experiment	56	56	56	56	56	56	56	56	56	56	56	56
Length of feeding period	184	186	193	145	135	156	143	142	150	122	131	140
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Av. initial weight per pig	21.0	20.0	26.0	33.0	33.12	22.0	28.89	27.14	29.17	37.50	40.00	30.00
Av. final weight per pig	201.0	200.0	200.0	201.0	200.6	200.0	200.0	210.43	200.00	200.36	201.25	200.00
Av. daily gain per pig	.98	.97	.90	1.16	1.24	1.14	1.20	1.23	1.15	1.33	1.23	1.21
Total feed consumed by pigs during fattening period	4438.50	5186.50	3637.50	3087.50	2694.50	4617.00	5290.00	5416.00	3989.00	3665.00	2448.50	4588.00
Feed required per 100 lbs. gain during fattening period	493.20	480.20	418.10	367.50	402.2	432.3	343.5	443.93	386.91	321.5	379.60	449.8
Feed consumed by sow 6 mos.	973.0	972.0	1048.0	1044.5	914.0	1014.0	1152.0	1157.0	1006.5	1142.50	998.50	1200.50
Total feed required by sow and litter	5411.50	6158.50	4685.50	4132.0	3608.5	5631.0	6442.0	6573.0	4995.5	4807.50	3447.0	5788.50
Feed required by sow and litter to produce 100 lbs. live weight	538.40	513.20	468.55	411.1	449.6	469.25	357.9	466.17	414.20	342.8	428.2	482.37

Reference: Alabama Agricultural Experiment Station Bulletin 234, "Grading Up Hogs by the Use of Purebred Sires," pages 3, 4, 5 and 6, tables 2, 3, 4 and 5, Auburn, Alabama, November 1930.

PART II

Diseases and Parasites

Diseases and parasites cause considerable loss to hog producers in the South. A successful hog producer should be able by diagnosis to recognize the common diseases or parasites that may be attacking the herd in order that the proper treatment may be given. Some diseases and parasites require the services of a skilled veterinarian for diagnosis and treatment. It is highly desirable that the successful producer of hogs should know when to call for the services of a skilled veterinarian.

To meet this need a discussion of the common diseases and internal and external parasites is given.

COMMON DISEASES OF SWINE

Hog Cholera: Hog cholera causes a greater annual loss to the swine industry than any other disease. It is very contagious and spreads rapidly through the herd, causing the death of practically all hogs infected. Quite often it appears in wide-spread epidemics and in such outbreaks it is responsible for the death of large numbers of hogs. Such epidemics are especially apt to occur when swine raisers decide to take a chance and do not vaccinate their hogs against the disease. Such a choice is always accompanied with great risk. The cost of vaccination is not very great when done at the proper age, which is at weaning time. It will be found that the cost of vaccination over a period of years is far less than the financial loss resulting from hog cholera outbreaks in herds not vaccinated.

Cause: Hog cholera is caused by a specific germ, technically known as the filterable virus of hog cholera, and hogs must become infected with this germ before they develop the disease. The virus gains entrance into the body mainly through contaminated feed and water. Sick hogs discharge the virus through the intestinal droppings, the urine, and discharges from the nose and eyes. Usually the symptoms are manifested within a week or ten days

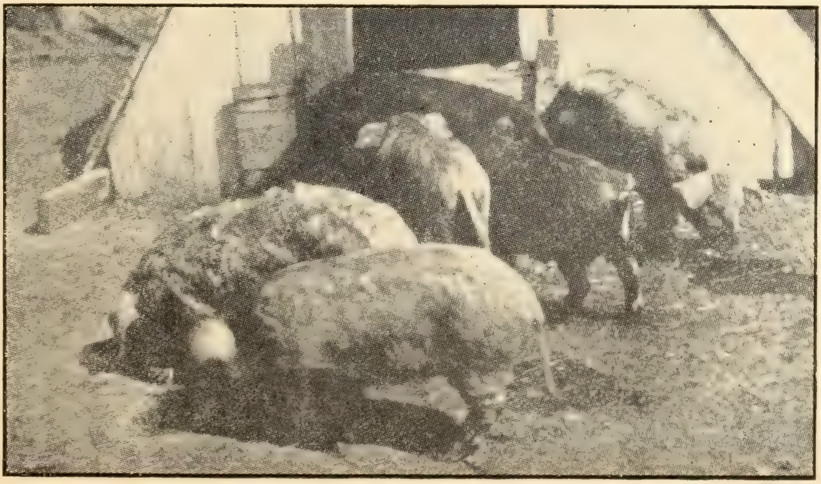

Figure 9.—Hogs infected with hog cholera.

after exposure to the virus. The sick hog is the most dangerous agent in spreading the virus. However, the virus may be carried on the feet of persons, by wagon or truck wheels, and by running water.

Symptoms: There are two types of hog cholera: acute and chronic. In the acute type the following symptoms are present: sluggishness, a desire to remain in the accustomed sleeping quarters, loss of appetite, vomiting, coughing, labored and rapid breathing, discharge from the eyes even causing eyelids to be glued shut, high temperature, profound weakness, and constipation at onset of disease followed by diarrhea. The mortality rate is exceedingly high.

In the chronic type, the animal becomes grealty emaciated, weak and unthrifty. A pronounced cough is present. The hair may be shed in some cases and sore areas often develop over parts of the body.

Post-Mortem Examination: Post-mortem examination is essential to determine as early as possible the cause of the trouble. An early post-mortem may materially reduce the loss due to an out-break of hog cholera.

Upon examining hogs with acute cases of cholera, marked congestion or reddening of the skin on the thin-skinned regions of the body will usually be found. Most usual location for these spots is on the underside of the chest and belly. Frequently the congestion and reddened area are turning purple before death.

Internal examination usually shows hemorrhage (small blood spots), enlargement and congestion of the heart, lungs, spleen, kidneys, and inner lining of the urinal bladder. The intestines are usually congested. The lymph glands are also affected. The normal gland is small and of a yellowsih-white color, while these glands in case of cholera are generally large and congested. Sometimes the congestion is so severe as to give the gland almost the appearance of a blood clot.

Controlling: Vaccinating is the only means of control in communities where cholera occurs. The vaccination should be done when the pigs are 8 to 10 weeks old.

There are two kinds of serum on the market. One is commonly called the defibrinated blood serum, which is red and colored like blood. The other is called clear serum. This clear serum is merely defibrinated blood serum from which the red blood cells have been removed. It is believed that the clear serum may be superior to the defibrinated blood serum.

Treating: Two methods are used in protecting hogs from cholera by immunization: (1) the serum-alone treatment, and (2) the simultaneous inoculation treatment.

The serum-alone treatment is used in some cases in treating hogs already sick with the disease. This virus should be injected into one of the following places: (1) the abdominal cavity, (2) the flank, (3) between the forelegs, and (4) in the neck, back of the ears.

The serum-alone treatment does not produce permanent immunity. Immunity by this method usually lasts from two to six weeks. The following doses are recommended by the Department of Agriculture. Not more than 10 cubic centimeters of serum in the case of pigs, nor more than from 20 to 30 cubic centimeters in the case of larger animals, should be injected into one place unless the injection is made into the abdominal cavity.

MINIMUM DOSES, SERUM-ALONE TREATMENT

Animal and weight	Doses of serum		Animal and weight	Doses of serum	
	Clear	Defibrinated blood		Clear	Defibrinated blood
	c.c.	c.c.		c.c.	c.c.
Suckling pigs	16	20	Pigs 90 to 150 pounds	36-52	45-65
Pigs 20 to 40 pounds	24-28	30-35	Hogs 150 to 200 pounds	52-60	65-75
Pigs 40 to 90 pounds	28-36	35-45			

U. S. D. A. Farmers' Bulletin 834.

The simultaneous inoculation treatment usually affords permanent immunity from cholera. In vaccinating by this method small doses of virus are administered in connection with the serum. The following doses are recommended by the United States Department of Agriculture:

MINIMUM DOSES, SIMULTANEOUS TREATMENT
(By Weight)

Animal weight	Doses of serum		Doses of virus
	Clear	Defibrinated blood	
	c.c.	c.c.	
Suckling pigs	16	20	At least 2 cubic centimeters of virus should be administered to each animal weighing more than 45 pounds; in the case of suckling pigs weighing less than 45 pounds, the dose may be reduced.
Pigs 20 to 40 pounds	24-28	30-35	
Pigs 40 to 90 pounds	28-36	35-45	
Pigs 90 to 150 pounds	36-52	45-65	
Hogs 150 to 200 pounds	52-60	65-72	

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In using this method of vaccinating, care must be exercised in handling the virus. If injections are not handled correctly death sometimes results. Do not expect wormy hogs to develop permanent immunity when inoculated with hog cholera virus. Hogs with temperatures should not be inoculated.

The simultaneous inoculation treatment, if possible, should be administered only by a competent veterinarian or by persons having considerable experience.

Care of Hogs: Special care should be given hogs before and after vaccinating. Hogs should be kept in dry, clean pens and given very little feed or water for 24 hours before they are vaccinated. Hogs should not be turned into muddy pens after treatment. Sloppy feed should be used for a few days after vaccination or if seasonable the hogs should be allowed to run on some form of green pasture as alfalfa, cowpeas or grass.

Reference: Florida Agricultural Experiment Station Bulletin 236, "Swine Production in Florida."

Swine Plague

The swine plague is technically known as hemorrhagic septicemia, which in reality is a form of hog pneumonia, and is sometimes found present in outbreaks of hog cholera. This disease is caused by the germ, **Pasteurella suisepticus** which is often found in the respiratory passages of healthy hogs but seems to be harmless until the vitality of the hog is lowered by disease or other causes.

It is quite impossible to distinguish between the symptoms of swine plague and hog cholera in the field. It seems, however, in swine plague the respiratory passages are involved more pronouncedly than in cases of hog cholera. Even with post mortem examination it is quite difficult to distinguish between cholera and swine plague. Swine plague rarely occurs as an independent disease.

Treatment: When swine plague occurs in connection with an outbreak of hog cholera the case should be handled and treated as hog cholera, as this disease is far more fatal. Serums are available for vaccinating against swine plague. Ths vaccination should be given when vaccinating for cholera to prevent the disease from attacking the hogs. Hogs that die of swine plague should be buried deeply, or preferably, burned.

Reference: Florida Agricultural Experiment Station Bulletin 236, "Swine Production in Florida."

Tuberculosis

Tuberculosis is a disease common to all domestic animals and man. In many cases it is slow in developing and hard to recognize until the later stages unless the tuberculin test is used.

Hogs usually contract tuberculosis by association with tuberculous poultry, eating tuberculous carcasses, being confined in infected feed lots, and following tuberculous cattle. When these sources of infection are eliminated, tuberculosis of swine will greatly decrease.

Even though the disease may have been present in a herd for a considerable period of time it is hard to detect by clinical examination. Intestinal tuberculosis is frequently accompanied by general disturbance of the digestive functions, and constipation or diarrhea may be shown. Advanced tuberculosis of the lungs is shown by a persistent, dry, harsh cough, and by rapid breathing, especially on exercise. This cough is similar to that caused by lung worms and cannot be distinguished from it. In most cases the presence of the disease is not detected until the animal is slaughtered.

Treatment: Prevention is the best means of combating tuberculosis. By this is meant care should be exercised in feeding hogs behind cattle, association with poultry, and feeding on uncooked garbage or packing-house by-products. By correcting such practices tuberculosis will be materially reduced in hogs.

The tuberculin test should be used at regular intervals to detect tuberculosis. The reactors should be removed from the herd, thus preventing spread of the disease. Hogs known to be affected wih tuberculosis should not be sold to the local butcher.

Reference: United States Department of Agriculture Farmers' Bulletin 781, "Tuberculosis of Hogs."

Influenza

Influenza is an infectious disease of hogs. The disease is transmitted by a virus that is present in the discharge from the nasal passages of hogs that have the disease. Swope produced the disease by injecting a germ-free filtrate, made from the lung tissue and lymph glands of a hog that had influenza, into the nasal passage of a well hog.

Reference: Pork Production by W. W. Smith, 1937 Edition, page 560.

Swine flu is characterized by the attack of a large portion of a herd at one time. The hogs lose their appetite. Spasmodic breathing is one of the first symptoms noticed. The disease is accompanied by violent fits of coughing, red and swollen eyes, and often a discharge from the nose streaked with blood. Occasionally a hog will vomit stringy mucous tinged with bile. Temperature at first usually ranges from 104° to 108° F., usually dropping to 103° to 104° F., in about a week, when, if the hogs survive, they are back on feed.

Treatment: The treatment for swine flu is almost entirely hygienic. Animals should be placed in warm, well bedded quarters with plenty of fresh air and drinking water. Little or no feed should be given during the first 24 hours.

Pig Diarrhea

Diarrhea or "scours" is a serious ailment of young pigs and usually takes considerable toll each year.

Scours is a condition resulting from improper care of both the sow and litter, and may occur in pigs varying in age and may continue from one day to several weeks. When this disease attacks very young pigs it is likely that the ration being fed the sow is responsible. Sometimes pigs allowed to stay in damp, unsanitary quarters, deprived of sunshine and exercise or exposed to cold, rainy weather contract diarrhea.

The chief symptom is a profuse discharge from the bowels. The discharge is of thin, fluid-like character, grayish-yellow in color and of a very foul odor. At first the appetite is not affected, but after a few days, pigs affected stop eating and nursing and soon begin to lose strength and flesh. The coat of hair becomes rough and pigs squall with pain when handled.

Treatment: Pigs attacked by scours when only a few days old usually die. Proper attention should be given to feeding the brood sow before and after farrowing to prevent anything of an irritating nature to be transmitted through the milk to the offspring. Nursing sows should be kept in a clean, warm, comfortable pen where the pigs have plenty of room, air, and sunshine. Pigs affected should receive a dose of castor oil to clean out whatever irritating substance there is in the bowels. If the diarrhea persists after this treatment, each pig should receive 2 cc. of subnitrate of bismuth.

INTERNAL PARASITES OF SWINE

The internal parasites which occur in swine show a wide variation in structure, size, shape, habits, location and degree of infestation. Some of these parasites are very simple in structure and so minute that they can be seen only through a high-power microscope. These minute parasites are known as protozoa. Other parasites are worms having a more or less complex structure. Worm parasites fall into three distinct groups, namely: flukes, tapeworms, and round worms. Round worms, or thread worms, are the most common or prevalent parasites of swine in this country.

Some swine parasites live in various portions of the digestive tract, others occur in the lungs, liver, kidneys, muscles and various other locations outside of the digestive tract.

Swine are seriously affected by internal parasites of various kinds, the parasitic infestations of these food animals being second only to hog cholera. Parasites cause unthriftiness, stunting, weakness and a striking high mortality among young pigs and in many cases cause injury to many vital organs, which later are more liable to become infested with bacteria and other disease producing agents. The migration of developing worms through various organs and tissues results in various disabilities.

Young pigs seem to be much more susceptible to infestations of internal parasites and suffer more severely than older pigs from such infestations, which would indicate that young pigs should receive special preventive care. This does not mean that older pigs are not damaged by internal parasites but that the damage is much more noticeable in young pigs.

The United States Department of Agriculture Zoological Experiment Station at Moultrie, Georgia, has conducted experiments to determine the effect of internal parasites on the growth and weight of pigs.

EFFECT OF INTERNAL PARASITES ON GROWTH AND WEIGHT OF PIGS
Average of All Tests—(3 Year Average)

Method of growth	Age of hogs at marketing	Average weight	Difference in length of feeding period	Gain per day
Not controlled (wormy way)	10 mo. 15 days	191 lbs.	3 mo. 10 days	.60 lbs.
Controlled (sanitary way)	7 mo. 5 days	187 lbs.		.86 lbs.

U.S.D.A. Zoological Experiment Station, Moultrie, Georgia.

The following tabulation shows the annual value of meat loss due to internal parasites at a single federally-inspected packing plant.

Annual loss from Kidney Worms—(6 Year Average)

Annual no. hogs	Condemned pork	Livers	Kidneys	Loins	Leaf lard	Other parts	Total loss	Loss per hog
147,504	$6,891	$20,145	$2,740	$7,860	$20,487	$1,640	$59,763	$0.40

Internal parasites also affect the size of litters raised. This fact is brought out in an experiment conducted by the Illinois Agricultural Experiment Station.

During 1925 a total of 608 farmers in 61 Illinois counties practiced a simple system of swine sanitation on their farms with striking success. These farmers were men who had volunteered to cooperate with the College of Agriculture, University of Illinois, in demonstrating the merits of swine sanitation in economical pork production.

By the end of the year one-fourth of these cooperating sent in similar reports. A summary of their experiences shows among other things that they were able to raise the usual number of pigs from one-fourth fewer sows than were raised under the old system of raising hogs; that they raised 98 percent of the pigs saved at farrowing time; that there were almost no runts among the sanitation pigs and that the pigs raised this way were heavier at four months of age, were produced more cheaply, were more uniform and reached market earlier than pigs raised under common conditions.

EFFECT OF INTERNAL PARASITES ON SIZE OF LITTERS RAISED

Conditions reported	Wormy pigs	Sanitation pigs
Total number of litters	112	229
Total number of pigs at 4 months	567	1623
Average number litters at 4 months	5.1	7.1
Total number runts at 4 months	103	13
Percentage of runts	18%	1%
Weight of pigs at 4 months	68 lbs.	86 lbs.

Four simple but necessary steps constitute the sanitation system. They are designed to protect the little pigs, until they are at least four months old and reasonably resistant to infestation from swallowing an incubated worm egg. These steps as used by the 608 project leaders in Illinois are as follows:

1. Clean the farrowing quarters by scrubbing them with 1 pound of lye to 30 gallons boiling hot water. The hot water kills worm eggs; the lye loosens the dirt; the disinfectant destroys germs of infectious diseases.
2. Washing the sows sides and udder with soap and water before putting her in a clean farrowing pen. This removes worm eggs from the sow so that the little pigs cannot get them when they suck.
3. Hauling (not driving) the sow and pigs to the pasture where no hogs have run for at least a year. Preferably this pasture should be a field which has been cultivated since last used by hogs. This avoids contamination from filthy hog lots.
4. Confining the pigs in clean pasture until they are at least 4 months old.

Experience has shown the hogs raised without access to contaminated hog lots or pastures until four months old are usually relatively thrifty.

Three systems were used to water pigs.

1. When the distance was short, water was sometimes piped from the barn lot well through pipes laid temporarily on top of the ground.
2. In parts of the country where the land is porous enough for tile drainage to be successful, many shallow wells were used until long after the water level sank below the tile. Most of them were dug with a post hole auger, the handle of which was extended by 4-foot lengths of gas pipe as the depth increased. The time required to put down a 15 to 20 foot well usually was not more than half a day for one or two men. If the ground crumbles easily, the well is lined with 6 inch tile. These can be let down one at a time with a pole into which a nail has been driven, near the end to support the tile while it is being lowered.
3. On many farms water was hauled to the field in a barrel or tank. An ingenious scheme was used on the farms of Ray Ferguson and William Stenzel in Henry County. A float was attached to a trough in the field. One end of a short rubber hose was coupled on the pipe leading to the float valve and the other end was coupled to the outlet pipe, of the wagon tank. The wagon stood in the field until it had been emptied through the float valve as the water was used. This saved the expense of an extra field tank.

Reference: Illinois Agricultural Experiment Circular 306. "Cheaper and More Profitable Pork Through Sanitary Swine Production," pages 3, 4, 11, 12 and 13, table 4, Urbana, Illinois, February 1926.

The above experiment clearly illustrates that internal parasites are detrimental to pork producers. To produce hogs successfully some attention should be given to controlling internal parasites. This attention can be given with less expense and trouble while the pigs are young, resulting in a much larger saving than waiting until the pigs are older.

Control Measures

Prevention in the broad sense covers all efforts that are directed toward avoiding infestation or minimizing its effects. The cardinal principle of prevention is sanitation or cleanliness. In the mind of many persons the term "swine" is practically synonymous with filth, this association being due no doubt to the filthy conditions under which swine are kept in some places.

Old hog lots with an accumulation of manure and litter combined with hog wallows are anything but a pleasing sight as illustrated in figure 10.

To expect animals to develop normally and produce healthy off-spring in such surroundings usually results in disappointment. For a normal growth and development, swine, like all other farm animals, require sanitary surroundings, a balanced and adequate ration and relative freedom from parasites as in figure 11.

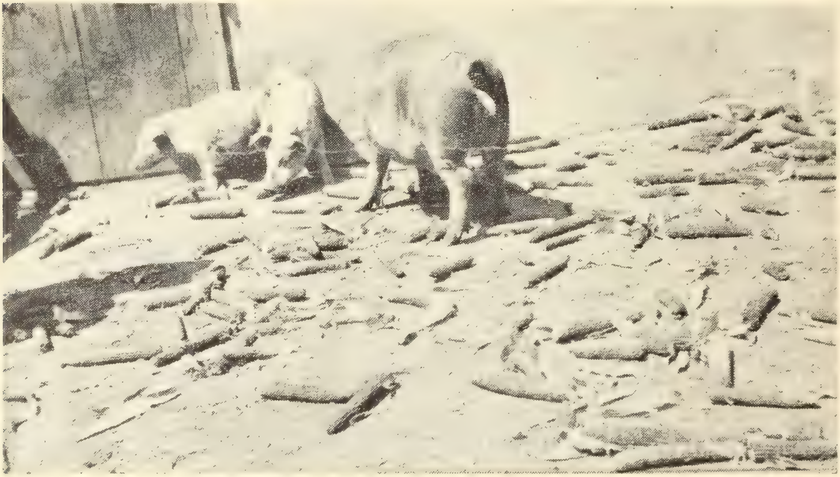

Figure 10. Hog lot with corn cobs and other litter favorable to development of parasites. The three pigs shown are the same age; the two small pigs show the effects of parasites and other hog-lot infections

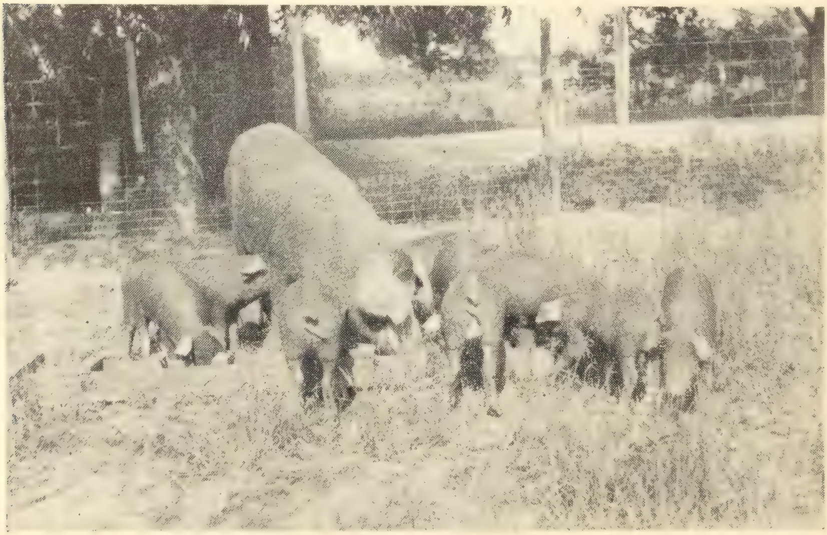

Figure 11. Sow and litter on clean, temporary pasture. Note uniform size of pigs and complete absence of runts. These pigs harbored very few parasites.

Sanitary surroundings include clean housing, free from manure, litter and dirt. The outdoor surroundings should consist of pasture sowed to suitable forage crops. The pastures should be well drained and provided with good fences to prevent pigs from getting into low, wet areas. Pastures should be free from litter, since eggs and larvae of parasites are deposited under accumulations of all sorts.

Permanent pastures are far less desirable than temporary pastures, but if permanent pastures must be used, it is desirable to rotate stock so as not to keep pigs year after year on the same pasture. Temporary pastures, if well kept, well drained and sowed to suitable forage crops offer the best and simplest solution to the control of swine parasites. Pigs produced under these conditions are more uniform in size, grow faster; and almost always more profitable pigs are produced than under less favorable conditions in that they are ready for market earlier and the loss of young pigs usually is much smaller.

In brief, the problem to be solved in connection with parasite control is the protection of pigs from parasites harbored by sows and older pigs. This can

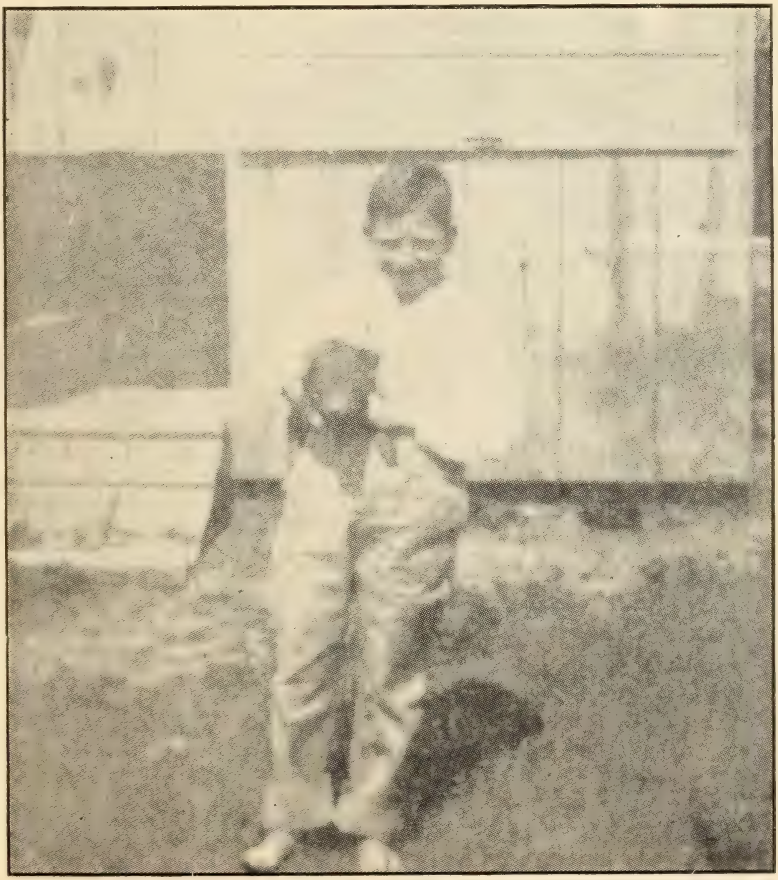

Figure 12. Individual portable farrowing house suitable for use in the South.

best be done by transferring the sows before farrowing to a temporary pasture that has not been used recently by other hogs. It is desirable to provide individual portable farrowing houses as illustrated in figure 12, on these temporary pastures. It is also important to keep all hogs, other than the sows, away from the suckling litters and young pigs to prevent contamination of the pasture with parasite eggs and larvae. These precautions will not prevent parasitic infection of the suckling pigs altogether, but will keep the infestation down to a low level. If the pigs are properly fed and housed, protected from association with old hogs, other than their mothers, and kept on clean pastures, before and after weaning, the little infection that they will inevitably acquire from association will do comparatively little harm.

By following a sanitary method the grower can reduce considerably the cost of producing his pig crop. The pigs are usually more uniform in size as illustrated in figure 13, runtiness being greatly reduced and the time for raising the animals to market age can be shortened by from four to eight weeks. This effects a saving in feed and care and reduces the risk of loss from infectious diseases because of the shorter holding period.

The control of parasites, especially the kidney worms, will be greatly facilitated by using a pasture arrangement as illustrated in figure 14. The bare area around the house, water barrel, feed pens and the area around the fence are usually much drier than the remainder of the pasture. A higher percentage of the eggs and larvae of the parasites will be deposited in these areas where they perish from exposure to sun light, heat and drying. In the absence of vegetation the top soil is sufficiently dry except during wet seasons to destroy life in the eggs and larvae of these worms.

By providing a separate feeding pen for the sow and at some distance away a creep and self-feeder for pigs, a considerable portion of infested ma-

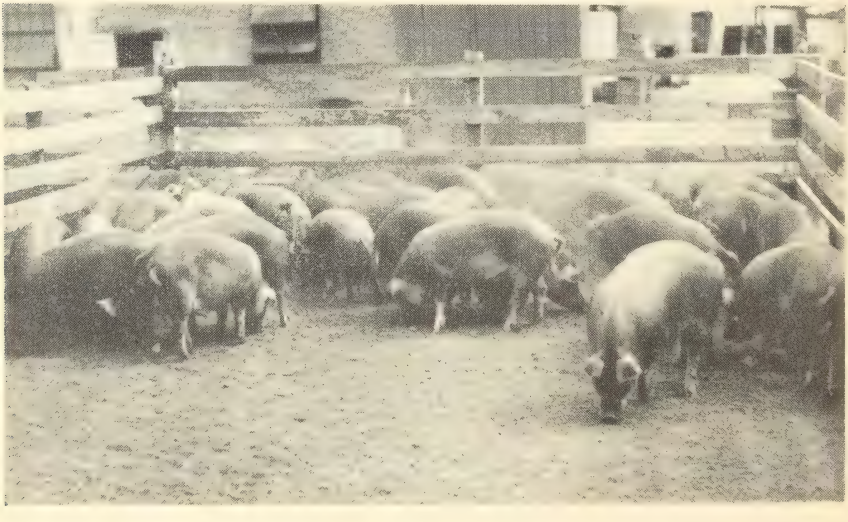

Figure 13. Pigs raised under the sanitation system; note uniformity in size and quality. These pigs averaged 220 pounds when they were 6½ months old.

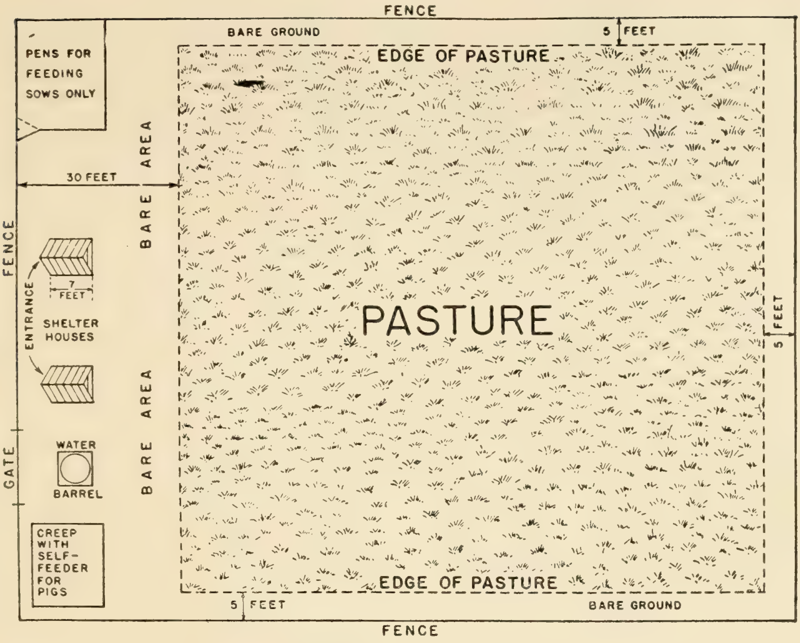
FENCE
BARE GROUND
5 FEET
PENS FOR FEEDING SOWS ONLY
EDGE OF PASTURE
BARE AREA
30 FEET
BARE AREA
FENCE
7 FEET
ENTRANCE
SHELTER HOUSES
PASTURE
5 FEET
WATER
BARREL
GATE
CREEP WITH SELF-FEEDER FOR PIGS
EDGE OF PASTURE
5 FEET
BARE GROUND
FENCE

Figure 14. Use of bare-ground areas to control swine parasites.

terial will be kept away from the pigs. The pigs should not be allowed to enter the sow's feeding pen.

This arrangement of feeding and pasture is very effective in combating the kidney worm infestation which is one of the most serious parasites which infest swine.

LIFE CYCLE OF INTERNAL PARASITES OF HOGS

Internal parasite	Life cycle			
	1	2	3	4
Lung fluke	Adult fluke in lungs produces eggs which are coughed up and swallowed.	Eggs discharged in droppings, hatch in swampy areas and young flukes get in aquatic snails and crawfish	Pigs eat crawfish containing young flukes	Young flukes in digestive tract bore their way through intestinal walls and reach the lungs and there develop to maturity
Hydatid (tapeworm)	Adult tapeworm in the intestines shed ripe segments	Ripe segments containing numerous eggs are discharged with droppings	Hogs acquire hydatids by swallowing feed or water contaminated with segments or eggs	Eggs hatch in intestinal tract and reach liver or other organs through the blood stream
Trichinae	Adult worms in the intestines produce numerous young	Young worms are carried to muscles by the blood	Worms enter muscles and develop there becoming enclosed in cysts	Pigs acquire Trichinae by eating scraps of raw pork or infested rats. The parasites are liberated from the cysts in the intestines
Thorn-headed worm	Adult worms in the intestines produce numerous eggs	Eggs eliminated in droppings of infested swine	May beetle grubs swallow the eggs and become infested	Hogs acquire thorn-headed worms by swallowing infested grubs
Lungworms	Adult worm in lungs produce eggs which are coughed up and swallowed	Eggs are eliminated by droppings and eaten by earthworms which live only in damp places and swamps	Pigs pick up eggs which live in litter and swallow while eating food	Eggs hatch and penetrate to the lungs
Roundworms (intestinal)	Adults in intestines produce eggs	Eggs eliminated in droppings, and stay alive in litters, shade and damp places	Pigs swallow infestive larvae with food or water through broken skin	Eggs hatch and larvae go back to intestines
Kidney worms	Adults in kidney and uriters	Eggs eliminated in urine and stay alive along fences in old pastures, and shady spots and develop into infestive stages in 4-6 days	Pigs eat earthworms with lung worm eggs	Larvae penetrates to liver, loins, kidney and ureters

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U.S.D.A. Farmers' Bulletin 1787, "Internal Parasites of Swine."

LIFE CYCLE OF INTERNAL PARASITES OF HOGS (Continued)

Internal parasite	Description	Damage	Treatment	Control
Lung fluke	Thick, oval worms about ¾ inch long about 1/5 inch wide. Located in sacks or cysts in substances of lung	No special symptoms have been noted	No known treatment for removal of fluke worms	Keeps hogs off wet, boggy areas
Hydatid	Bladder worms located principally in the liver and lungs of swine. Vary in size and shape, in swine from the size of an orange downward. The bladder is filled with clear fluid containing minute objects resembling grains of sand. Each minute object is capable of giving life to a tapeworm	No distinctive symptoms have been noted to infected swine. Due to the size of the cysts and their location in vital organs these parasites are decidedly injurious. This parasite often infests human beings, necessitating surgical operations of a very serious nature		Control wandering of dogs over pasture and hog lots. Periodic treatment of pigs to remove tapeworms
Trichinae	Slender thread worms adults in small intestines, larvae stage in the blood. From blood to cysts in muscles. Adults 1/16 to 1/6 inch long. Size of very fine thread. Occur not only in swine but also in humans, rats, mice, dogs, cats and various other animals	Produces disease known as Trichinosis. Affected hogs usually take no food, vomit at times, move with difficulty and frequently lie motionless in one place. There may be considerable swelling, especially of the eyelids. Infected hogs usually recover. The encyster worms may remain alive in the muscles for a year or longer	There is no known effective treatment for	Trichinosis in swine involves management tending to eliminate the sources of infestation. Hogs should not be allowed to eat uncooked pork, garbage or offal from slaughter houses. Hogs that die on the farm should be buried deeply in quick lime or preferably burned. Sanitary methods should be used in producing
Thorn-headed worm	Milk white to bluish in color, cylindrical in shape, the largest being about the size of a lead pencil. The head is provided with a spiny proboscis (snout)	At point of attachment to the intestinal wall a swelling or nodule appears. Sometimes the injury is so deep that the intestine is perforated which causes peritonitis. This condition often results in death of the animal, causes great unthriftiness that is nearly always associated with parasitic infection	Drugs are rather ineffective in removing thorn-headed worms. Control measures are about the only hope at present of keeping swine free from thorn-headed worms	Ringing the noses of swine, sanitation and the avoidance of old hog lots and permanent pastures

Lungworms

Three species of lungworms, **Metastrongylus elongatus, M. salmi,** and **Choerostrongylus pudendotectus,** occur in swine; the first- and third-named species occurring in relatively large numbers, as a rule, whereas the species listed second usually occurs in small numbers, when present. Swine are usually infested by two or all three species, all of which are relatively long, slender, whitish worms, from about one-half to 2 inches long by about one-fiftieth of an inch or less wide as illustrated in figure 15.

These parasites are found occasionally in the windpipe, more often in its two main branches called the bronchi, their preferred location, however, being the smaller bronchi and the bronchioles (the finer branches of the bronchi), and especially those in the lower portions of the lungs. So far as is known, the three species of lungworms which parasitize swine are equally injurious, the degree of injury produced depending upon the number of worms present in individual pigs.

Damage produced: The most outstanding symptom of lungworm infestation is a cough, a condition which weakens an animal, particularly a young animal, and lowers its vitality. Young pigs have been known to die as a result of heavy lungworm infestations. In heavy infestations the finer bronchi and bronchioles are plugged with worms, and this produces a localized pneumonia. During the early stages of invasion by these worms, the lungs are peppered with hemorrhages resulting from the perforation of the walls of the delicate blood vessels in the lungs. In infestations of long standing the posterior tips of the lungs commonly show grayish, hardened areas marking the location of worms in the bronchi and bronchioles.

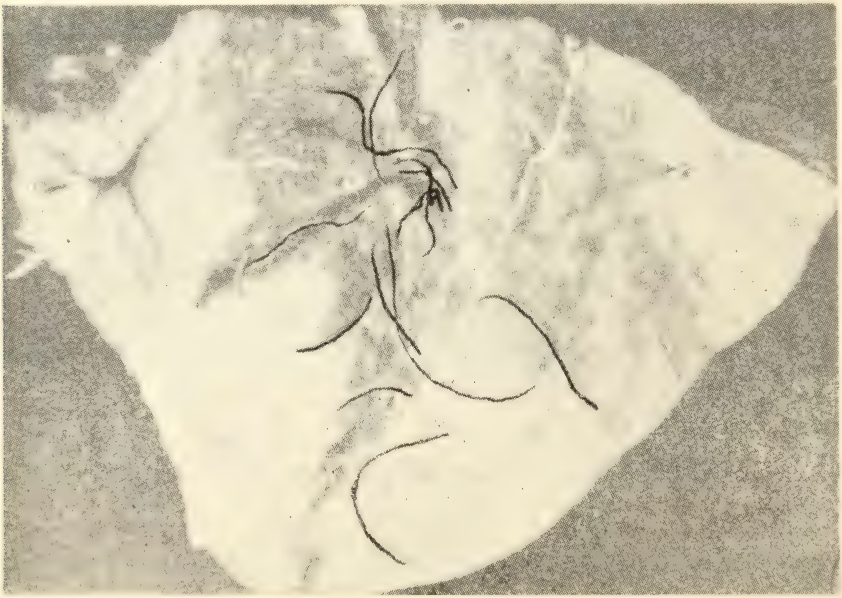

Figure 15. Lower portion of swine lung partially cut open to show the nests of lungworms. Several lungworms were removed to show their size and shape.

Treatment: There is no known medicinal treatment effective in removing these worms from the lungs. Infested animals should be taken off the pasture or out of the lot and placed in a dry, clean pen, preferably one with a concrete floor, to insure against further infestation from swallowing infested earthworms. While kept in isolation, sick pigs should be supplied with good feed in abundance, safe drinking water, and good bedding that is renewed at fairly frequent intervals.

Prevention: The control of lungworm infestation in pigs involves arrangements which will reduce the number of earthworms on pasture and lots and prevent swine from rooting. Earthworms thrive in old hog lots in which manure and litter accumulate, on permanent pastures, and in low fields which receive drainage from higher fields. Well-drained fields, on which crops are cultivated seasonally, contain comparatively few earthworms.

Effective control of lungworm infestation involves the use of the sanitation system of swine management, the absolute avoidance of old hog lots, and the selection of well-drained pastures, fencing off, if necessary, the lowest portions of pastures to which rain and wind carry manure and other litter. As an additional precaution, it is important to ring the noses of swine to prevent excessive rooting.

The Large Intestinal Roundworm

The large intestinal roundworm, **Ascaris suis,** is a large, thick, yellow or pink worm about the size of an ordinary lead pencil. The normal location of the adult parasites is the small intestine; wandering adults may occur also in the stomach, in the lower portion of the alimentary canal, in the bile ducts of the liver, in the gall bladder and in other parts of the body which have channels of communication with the gut. The young migrating worms occur in the blood stream, the liver, lungs, and other organs and tissues.

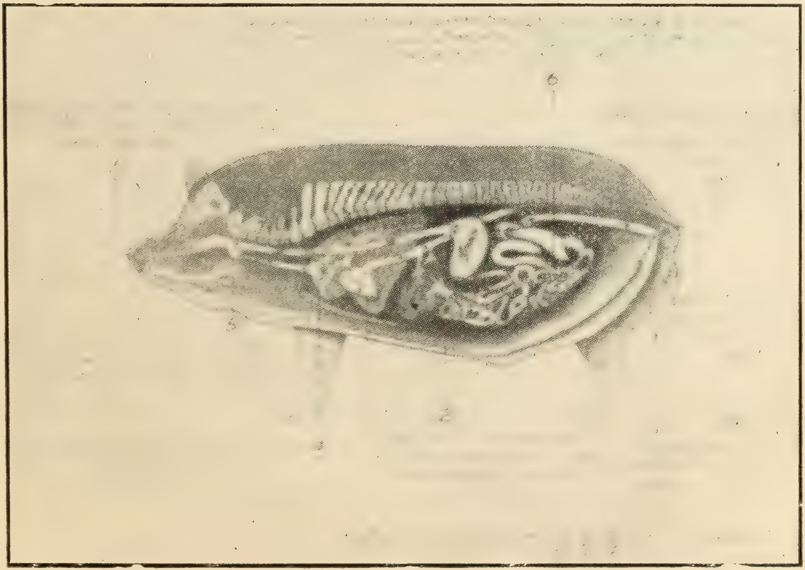

Figure 16. The roundworm's journey through the pig.

Damage produced: Roundworms in the intestine may produce digestive disturbances and a capricious appetite, retard growth and development, and interfere with the well-being of pigs in other ways.

In exceptional cases, particularly when pigs are on an inadequate diet, infested animals may become anemic, suffer from colic and, in extreme cases, they may suffer from convulsions. During the migration of numerous young ascarids through the lungs, pigs have difficulty in breathing and may die of pneumonia. Probably many, if not most, cases of thumps in young pigs are caused by ascarid migrations through the lungs, but other causes of thumping must not be overlooked. Pigs that survive a severe infestation of the lungs with ascarid larvae may not recover fully and often fail to grow and develop at a normal rate. Pigs are far more susceptible to ascarids than grown hogs, and very young pigs suffer seriously from the effects of these parasites.

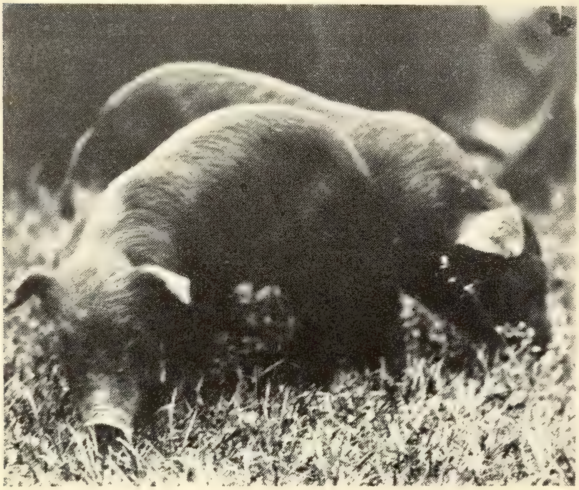

Figure 17. Pigs showing the effects of roundworm invasion of the lungs 8 days after infection.

Although the damage to the liver and lungs done by the migrating larvae heals as a rule, the liver is sometimes permanently affected by the massive migration of young worms. The repair to the damage results in numerous scars, the entire surface of the liver becoming peppered with whitish areas. In some lots of hogs as many as 35 percent of the livers have been thus affected.

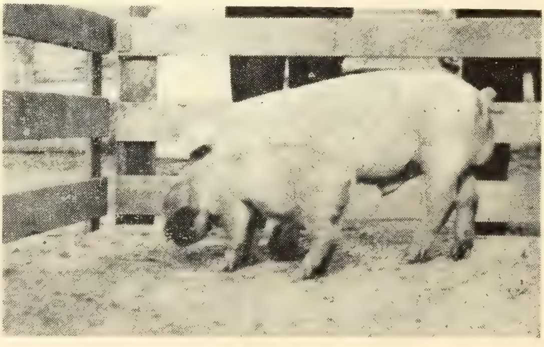

Figure 18. Two pigs of the same age. The large one is normal; the small one was stunted by roundworms and other hog-lot infections.

Treatment: The most satisfactory treatment for the removal of ascarids from the intestines of swine consists in the administration with a dose syringe or by means of a stomach tube of wormseed oil (oil of chenopodium) at the rate of one-half to 1 fluid dram (2 to 4 cubic centimeters) to a 100-pound animal, immediately preceded or followed by at least 2 fluid ounces (60 cubic

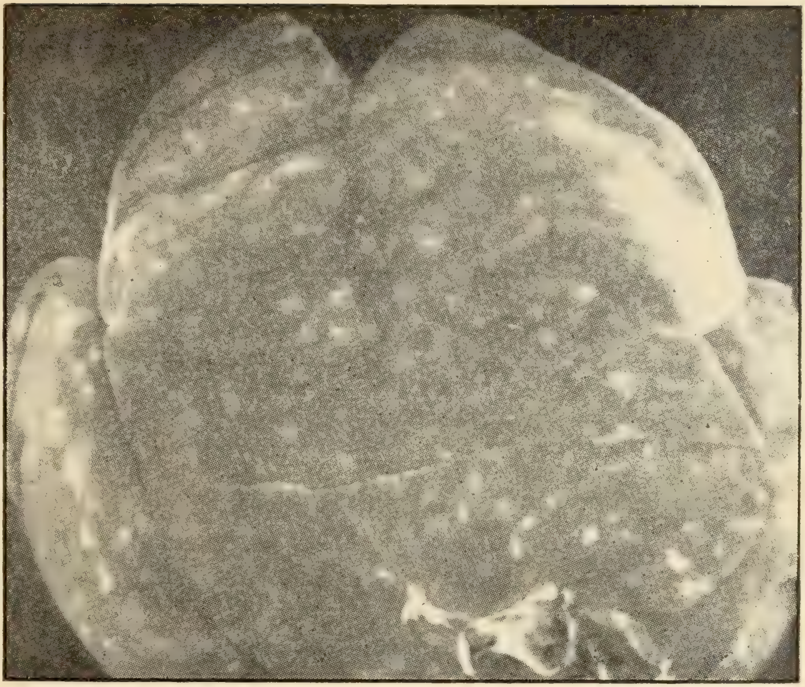

Figure 19. Swine liver showing numerous small scars (whitish areas) produced by migrating ascarid larvae.

centimeters) of castor oil, or the drug may be administered in the oil. Some veterinarians substitute calomel or aloes for castor oil; others use Glauber's salt or Epsom salt in solution on oats or in slops at the rate of 1 pound of salt to 10 hogs, 3 hours after treatment. Although doses for animals of various sizes are usually computed on the basis of weight, it is likely that a dose of 2 fluid drams of oil of chenopodium is adequate for hogs weighing 300 to 400 pounds. Swine should be fasted for 18 to 24 hours prior to treatment and should not be fed or watered for 3 hours after treatment. Oil of chenopodium should not be administered to animals suffering from fever, constipation, intestinal catarrh, or necrotic enteritis, and the treatment should not be given to very young animals or to pregnant sows.

Santonin, for a long time regarded as an effective remedy for the removal of roundworms from swine and commonly recommended for this purpose, is not very effective in the doses which have been usually recommended. When santonin is administered in relatively large doses, one-sixth to two-thirds grain per pound of body weight, followed in 12 hours by 1 gram of Epsom salt per pound of body weight, a large percentage of ascarids is removed.

It has been shown, by experiment, that hexylresorcinol will remove a large percentage of ascarids from swine in doses of 1 dram (4 grams) for pigs weighing between 30 to 50 pounds. This treatment was given after a preliminary fasting period of at least 36 hours and the treatment was followed immediately by 1 to 2 fluid ounces (30 to 60 cubic centimeters) of castor oil.

The high cost of the drug and the long period of fasting make this treatment rather impractical.

Although there has been a great demand for treatment that can be administered in the feed to a number of swine at the same time, this method of administering drugs is not recommended, despite the fact that it would save time and labor. After careful testing, mineral mixtures, often recommended as valuable in removing worms, and preventing infestation, have been found to be ineffective for these purposes. Mineral mixtures have their value in swine management and should be used for the purpose of supplying necessary mineral constituents, but they should not be considered as worm remedies.

Control: Control of ascarid infestation in swine can be accomplished successfully by following the sanitation system of swine management. This system was developed by the Federal Bureau of Animal Industry with farmers in the Middle West, in the South, and elsewhere in the United States. The swine-sanitation system, outlined in the section entitled "Internal Parasites of Swine," is the basis on which control measures for all swine-parasites should be undertaken, the system as a whole requiring certain modifications here and there, in order to adapt it to the control of parasites other than ascarids. Modifications already worked out in detail for kidney worms are discussed elsewhere in this bulletin. The basic sanitation principles as worked out for ascarids, will control effectively or to some extent practically all the important swine parasites.

Swine Kidney Worm

The full-grown parasite, **Stephanurus dentatus,** is a thick, mottled worm, from a little less than 1 inch to somewhat more than 2 inches long and from about one-twentieth to one-tenth of an inch wide. The mature worms occur

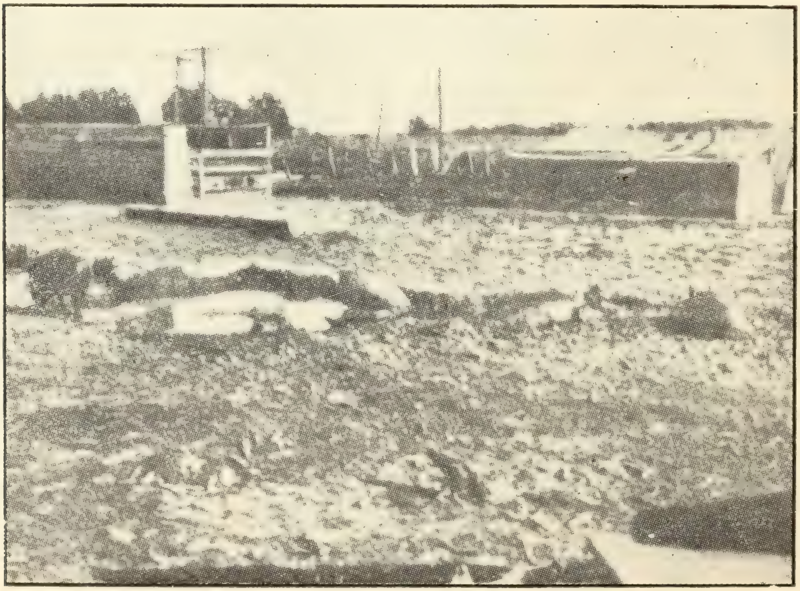

Figure 20. Hog lot in which kidney-worm larvae as well as eggs and larvae of other swine parasites are likely to be abundant.

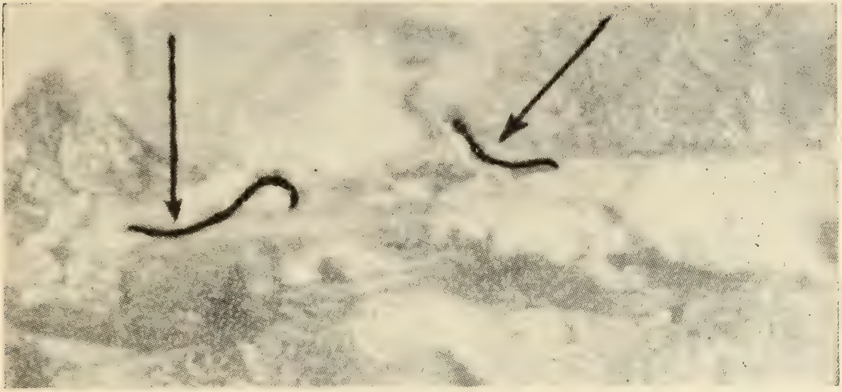

Figure 21. Portion of spine of a hog split open to show kidney worms in spinal canal. Arrows point to the worms (seen as long dark bodies).

in cysts in the fat surrounding the kidney and sometimes in the kidney tissue proper. The incompletely developed and sexually immature worms occur principally in the liver, in various blood vessels, especially those of the liver, free in the abdominal cavity, embedded in the loin muscles, and in the lungs; occasionally kidney worms penetrate the spine

Damage produced: Aside from general unthriftiness and arrested development, symptoms common to parasitic infestations of all kinds, there are no readily observable symptoms that are especially characteristic of kidney-worm infestation. Infested animals discharge urine which at times contains pus, this being characteristic of kidney-worm infestation. Posterior paralysis is sometimes due to the penetration of kidney worms in the spine. (Figure 21.)

Most cases of paralysis of the hind quarters are due, however, to other causes.

Post-mortem on a sow at the Mississippi Experiment Station showed evidence of kidney worms causing sufficient hemorrhage to produce death in the host.

It is evident that parasites as widely distributed throughout the bodies of swine as are kidney worms will produce more or less serious damage in the tissues and organs in which they lodge or with which they come in contact. The principal injury inflicted by the kidney worm involves the liver. The worms that migrate through the liver and perforate its capsule produce bloody tracks as illustrated in figure 22. As these active lesions heal, the damaged liver cells are replaced by hard connective tissue which produces the grayish-white liver scars characteristic of kidney worm infestation. These hard areas may be small, circumscribed, and more or less superficial or large and striking and extending deeply into the liver tissue. Pus is commonly associated with the worms which lodge in the liver lesions. Under meat-inspection procedure considerable losses are sustained owing to the rejection and condemnation of affected livers. The invasion of the loin muscles necessitates considerable trimming of expensive parts of hog carcasses. When the infestation is excessive and is accompanied by pus, considerable portions of a carcass and sometimes an entire carcass must be condemned. These losses are ultimately borne by swine producers, who receive a lower price for hogs because of ex-

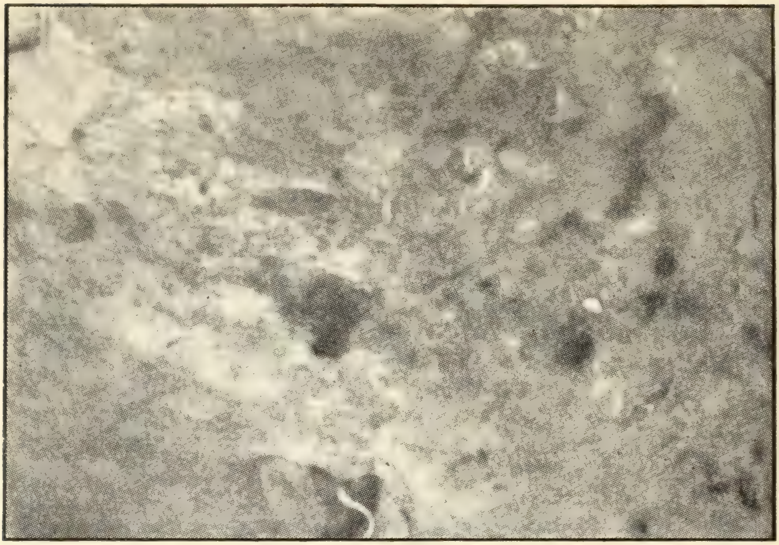

Figure 22. Swine liver with numerous bloody tracks produced by kidney-worm migration.

pected injuries as well as because of the injuries to hog carcasses actually produced by the parasites.

Other important injuries produced by kidney worms involve the lungs, which contain hard nodular masses marking the locations of the worms and associated pus; the blood vessels, in which incompletely grown worms become arrested and in which they produce changes that interfere with the circulation of the blood; the ureters, the walls of which become thickened when the worms lodge in them; the kidney fat, which is unfit for rendering into lard because of the infestation with worms; and the spleen and other organs which are sometimes invaded by the parasites.

Treatment: There is no known medicinal treatment for the removal of kidney worms from the blood vessels, liver, kidney fat, kidney proper, lungs, loin muscles, or the other locations in which these parasites occur.

Prevention: The control of kidney worm infestation must be based on preventive measures. Prevention in this case means reducing pasture contamination by observing certain fundamental precautions as regard sanitation, this in turn involves arrangement which will expose kidney worm eggs and larvae to the sun, prevent the accumulation of litter and trash on hog pasture and provide good drainage.

The system of pasture arrangement as outlined in figure 14 above is very effective in controlling the kidney worm.

EXTERNAL PARASITES OF HOGS

External parasites tend to lower the vitality of hogs making them more susceptible to different contagious diseases and cause considerable damage to the hog producer. The more common external parasites are hog lice, hog mange and screw worms. In some cases heavy infestation of these parasites, especially the screw worms, results in death. If hogs are to be produced successfully steps should be taken to control these parasites.

Controlling lice and mites (or mange): Hog lice are prevalent in all parts of the United States where hogs are raised. The lice obtain their food by puncturing the skin of the host animal and sucking the blood and lymph. A new puncture in the skin is made each time a louse feeds. Each skin puncture causes considerable irritation and itching and as each louse feeds at frequent intervals the irritation and itching is almost constant in cases of gross infestation. To relieve the itching the infested animals scratch themselves with their feet and rub violently against any convenient object, resulting in the destruction of the hair in patches often causing wounds in the skin. The lice congregate around these wounds and thus cause further irritation.

Lice may attack hogs of any age or condition causing an increase in the quantity of feed required to produce a pound of gain. It is estimated that young pigs allowed to remain infested with lice until butchered lose from 2 to 6 percent of their market value, and in many cases, due to the lower vitality, the hogs are much more susceptible to other parasites and contagious diseases.

The full grown female often attains a length of one-fourth of an inch. The male louse is slightly smaller and can be distinguished by a black streak on the underside of the abdomen along the middle of the last three segments.

The entire life cycle is passed on the host. Eggs or "nits" are deposited or glued on the hair close to the skin. Favorite locations for egg deposits are the lower half of the sides, around the shoulders, neck and flanks. Females lay from 3 to 6 eggs per day, the average length of the laying period is about 25 days. Eggs hatch in from 12 to 20 days, the majority hatch in from 12 to 15 days. Young lice become active soon after hatching and seek the parts covered by tender skin for feeding. Large numbers of young lice feed inside the ear, especially during cold weather. The young lice reach maturity and mating occurs when about 10 days old. The female begins laying eggs when about 12 days old and the average length of life is about 35 days.

Hog Mange: Mange is a term applied to two contagious skin diseases caused by insect-like parasites known as mites which live in the skin. The two species of mites are (1) Sarcoptes and (2) Demodex.

Sarcoptic mange mite: These mites are whitish colored and mature females measure about 1/50 inch and the male about 1/60 of an inch in length. The body is round and the bluntly rounded head is as broad as it is long. When mature these mites have four pairs of short, thick legs, the fourth pair and usually the third pair not extending beyond the length of the body.

The entire life cycle is passed on the body of the host animal. The mites penetrate through the upper layer of the skin and excavate burrows or galleries in which the eggs are laid. The female may lay from 10 to 25 eggs during the laying period which probably lasts from 12 to 15 days after which the female dies in her burrow. The eggs hatch in from 3 to 10 days and young mites reach maturity and begin laying eggs in 10 to 12 days. A new generation of mites may be produced every 15 days.

Sarcoptic or common mange may start on any part of the body, but usually the lesions are found first on the head around the eyes, nose or ears. From these parts it spreads finally involving the entire body. The presence of the mites on the "quick" or sensitive skin tissues causes great irritation and the skin under and around each burrow becomes inflamed and swollen. These swollen areas are somewhat larger than a pinhead and often have a yellowish-colored granule or dried serum adhering to it. The hair over the affected part stands erect and some of it drops out or is rubbed off. The affected areas of skin often take on a dry, scurfy, or leather-like appearance. The intense itching causing the animal to scratch the affected part until the skin becomes raw thus causes a running together of the small granular areas, and large scabs are formed. The surface of the lesion may have a dry, pearl-gray appearance or it may be moist and stained a reddish-yellow by blood and serum. In chronic cases the odor from the moist form sometimes is very offensive.

Sarcoptic or common mange of hogs is contagious and is usually spread by direct contact with infected animals. The disease is readily transmissible to man and also from hogs to other animals. The disease may persist in man for 30 days or longer and cause extreme annoyance.

Demodectic Mange (Follicular Mange): Mites causing this type of mange are truly microscopic in size; the full grown female reaches approximately 1/100 inch in length. They penetrate into the hair follicles and sebaceous glands of the skin where the entire life cycle is completed. In small numbers they apparently cause the animal no serious inconvenience, but in large numbers well marked lesions are caused in the skin of the affected animal. The disease is contagious to all classes of hogs. Lesions appear first on the snout or around the eyelids and spread slowly to the underside of the neck, breast, abdomen, inner sides of the hind legs and other parts of the body where the skin is thin and tender. In the early stages of the disease the affected skin may be red and scurfy, and small hard nodular lumps ranging in size from that of a pinhead to that of a hazelnut appear in the skin. A nodule may be dark red or it may be light red with a whitish or cream colored center. As the disease advances the nodules break and distribute a cream-like pus or lumps of matter of a cheese-like consistence.

There is no specific cure for demodectic mange, although frequent dippings in crude petroleum checks the progress of the disease and heals many of the old lesions.

Treatment for Lice and Mange: The common methods of applying treatment for lice and mange are:

(1) **Hand applications:** The following remedies when applied by hand have proven effective for lice and mange: (1) crude petroleum, (2) cottonseed oil and kerosene (equal parts) and (3) kerosene and lard mixed in proportions of one-half pint kerosene to 1 pound of lard. These remedies may be applied with a brush, mop or cloth, and should be distributed in a thin even coating over the entire surface of the head and body, including the inner surface of the ears and between the thighs.

(2) **Spraying:** Spraying is a rather expensive method of treating lice and mange, as much of the dip runs off and is wasted. An ordinary hand spray pump is suitable for the purpose and any of the dips recommended for scab may be applied in the form of a spray.

(3) **Hog oilers or rubbing posts:** Hog oilers or rubbing posts are devices so arranged that when a hog rubs against them a small quantity of oil

is deposited on or near the spot of skin being rubbed. They may be divided into two general classes, (1) home-made rubbing posts and (2) the patented hog oilers. This will help to some extent, but will not eradicate. If complete eradication is desired, burnt oil drained from crank case used unsparingly will eradicate lice.

(4) **Medicated hog wallows:** By medicating the water in properly constructed wallows, remedies for lice and mange may be applied in a satisfactory manner with a minimum expenditure of money, time and labor.

For pigs weighing from 40 to 80 pounds the wallow should be charged with liquid to a depth of about 3 inches. For hogs weighing from 80 to 150 pounds about 4 inches of liquid is sufficient. For a lot of mixed sizes from 3 to 4 inches of liquid should be used. The wallow should not be medicated under 24 to 48 hours at one time. Medicaments may be added every week or ten days until the desired results are obtained. In using oil in wallows add about 1 pint for each pig and about 1 quart for each hog.

(5) **Dipping:** Dipping consists in immersing animals in a medicated liquid that will kill the parasites. During dipping, the liquid in the vat should be from 40 to 48 inches deep, which is sufficient to swim the tallest animal.

Men with dipping forks should be stationed along the vat to render assistance and to keep each animal's body submerged while it is swimming through the vat. The head of each animal should be completely submerged at least once before it leaves the vat, being sure that dip enters the ears of each animal.

There are a lot of different dips that may be used. Oil dip: Fill vat to within 6 or 8 inches of dip line after which add the oil. Fuel oil may be improved by adding 1 gallon of kerosene to 10 gallons of fuel oil. The oil dips are used cold and 1 dipping is usually sufficient to eradicate lice or mange. This is the most effective dip used.

Lime sulphur dip may be used for hog mange when four or more dippings are made with an interval of 6 or 7 days between dippings. The temperature of the dip while the animals are in it should be maintained at from 95° to 100° F. Lime sulphur dip is made in the proportion of 12 pounds of unslaked lime (or 16 pounds of commercial hydrated lime) and 24 pounds of flowers of sulphur to 100 gallons of water. Slake the lime in a shallow water-tight box or tank and add water enough to form a thin paste. Sift the sulphur into the paste and mix well until the mixture is about the consistency of mortar, adding water as required. Put the mixture into 30 gallons of boiling water, adding slowly so as not to interrupt the boiling. The boiling should continue from 1½ to 2 hours until the sulphur has disappeared from the surface and the mixture is a chocolate or dark amber color.

Coal-tar-creosote dips: The coal-tar-creosote dips when properly used in soft water are fairly effective in eradicating hog lice if two or more dippings are given with an interval of 15 or 16 days between dippings. This is necessary because the first dipping does not destroy the eggs. These dips have not proved to be dependable remedies for mange. They may be used cold or warm, but the temperature of the dip while the hogs are in it should not exceed 95° F.

The dips are sold under many different trade names, and the principal ingredient is so-called creosote oil which is made soluble in or miscible with water by means of soap. In the undiluted coal-tar-creosote dips, especially in cold water, a separation of naphthalene and other constituents of the dip may occur. Care should be taken, therefore, to see that the dip is homogenous in character before using any portion of it. These dips should be diluted for use in accordance with the directions given on the containers.

Arsenical Dip: The arsenical dip as used for eradicating cattle ticks in the Southern States is an effective remedy for hog mange when four dippings are given with intervals of six or seven days between dippings. As crude-petroleum dip is much more economical and effective, the use of arsenical dip for hogs is not recommended except when a farmer in the southern tick area may have a few infected hogs he can dip in a cattle vat.

Reference: U. S. Department of Agriculture Farmers' Bulletin 1085, "Hog Lice and Hog Mange, Methods of Control and Eradication."

Screw worms: Life History—The primary screw worm fly has four stages in its life cycle; these are the egg, the larva or screw worm, the pupa, and the adult fly. The adult female cements masses of eggs to the edge of a wound or to the soiled skin below the wound. The egg hatches in 11 to 21 hours. Young screw worms invade the wound, feeding close together and forming a pocket in the living flesh. Screw worms become fully developed in 4 to 10 days, crawl out of the wound, drop to the soil, conceals itself near the surface of the ground, and changes to the pupa or resting stage. This stage usually lasts about 7 days. When the flies emerge from the pupa case they mate, and within 5 to 10 days the females are ready to lay eggs. The average life cycle is about 24 days.

The adult fly is about the size of the common house fly, bluish-green in color with 3 dark stripes on the back between the wings and with a yellowish-red face. Newborn pigs may be attacked in the navel and not infrequently in the mouth around the teeth or any place where there is blood or a fresh wound.

Treatment: Proper treatments, as described below, kill screw worms without injuring the wounds.

(1) Swab the wound with cotton to remove pus, blood, and blood serum. Spray benzol (commercial 90 percent) into the wound with a rubber-bulb syringe to stop the flow of serum and blood.

(2) Add more benzol and plug the opening of the wound with cotton. The excess benzol is absorbed by the cotton, and fumes are confined to the cavity of the wound. The fumes of benzol kill screw worms when they are breathed by the worms. Do not remove worms or cotton, for they will drop out naturally.

(3) Cover the cotton plug and wound with dehydrated pine-tar oil (specific gravity 1.065) to keep flies away and to aid healing. Thin applications of pine-tar oil should be made to the wounds every day or two until healing is complete.

Mistreatments with coal-tar creosote and strong stock dips delay healing and cause large wounds that furnish breeding places for screw worms for a long time.

When wounds are difficult to treat or when they occur in valuable animals, the services of a competent veterinarian should be secured.

Reference: U. S. Department of Agriculture Leaflet 162, "Screw-worm Control."

PART III

Houses and Equipment

Equipment occupies an important place in a production program of any kind. The planning of a system of pork production should include and provide for the necessary equipment that will enable the most profitable production of pork.

Due to the generally mild climate in Mississippi it is not necessary to provide expensive houses for hogs. Farrowing houses are desirable, especially for sows farrowing during the winter months. Portable farrowing houses are very desirable. Figures 23 and 24 illustrate the box type portable farrowing house and figure 25 illustrates the "A" type farrowing house. Each house is so constructed as to provide proper ventilation during the summer months.

The shed type house is preferred in most cases. The "A" type house is hard to clean, and sows very often get back against the wall and it is hard for them to get on their feet again.

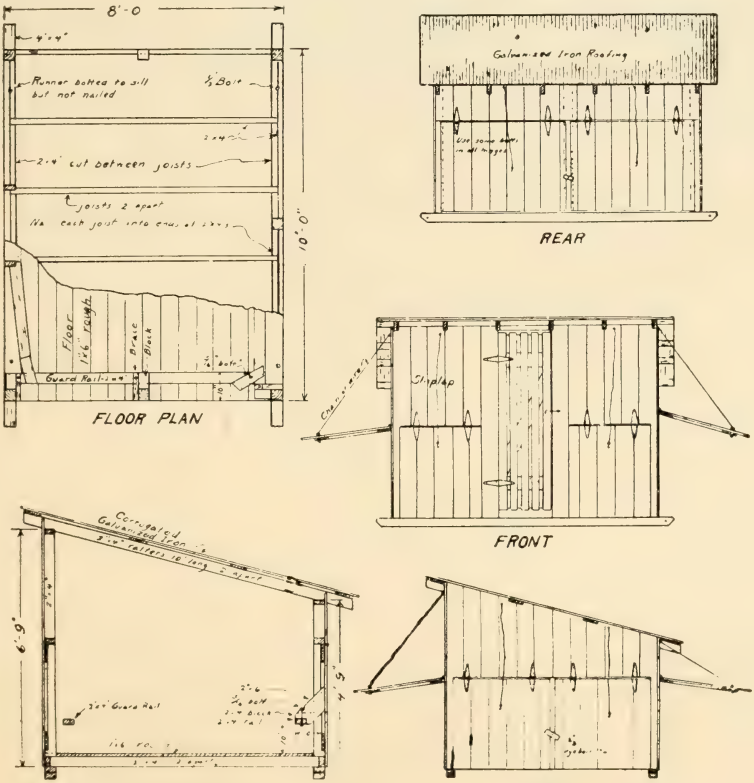
8'-0
4"x4"
Runner bolted to sill but not nailed
½ Bolt
2x4
2x4 cut between joists
joists 2' apart
10'-0"
Floor 1x6 rough
Brace Block
Guard Rail 2x4
½ bolt
FLOOR PLAN
Galvanized Iron Roofing
REAR
Shiplap
FRONT
Corrugated Galvanized Iron
2x4 rafters 10' long 2' apart
6'-9"
4'-5"
2x4 Guard Rail
2x6
½ bolt
2x4 Block
2x4 rail
1x6 rough
SECTION
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Figure 23. Texas shed-roof portable farrowing house.

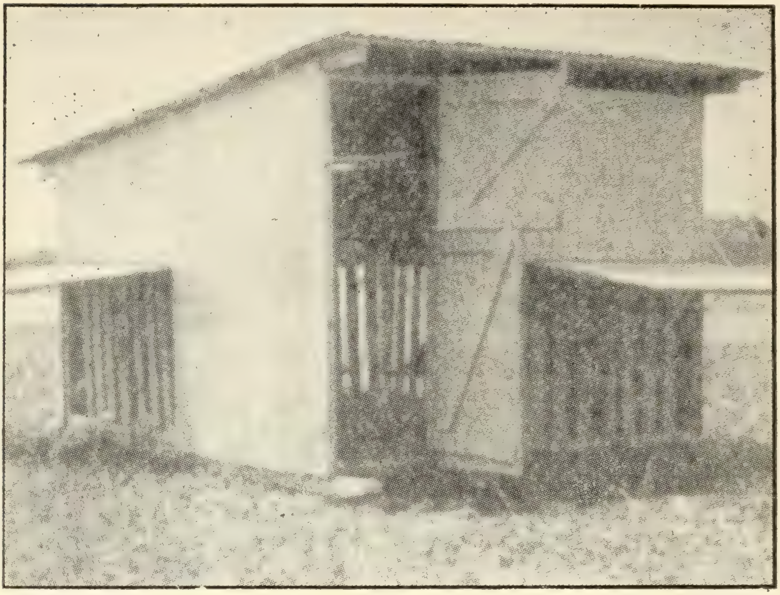

Figure 24. Texas shed-roof portable farrowing house.

BILL OF MATERIALS FOR TEXAS SHED-ROOF PORTABLE FARROWING HOUSE
(8 feet wide, 7 feet deep)

No. pieces	Dimensions
2	4″ x 4″ x 10′ for runners
2	2″ x 4″ x 4′6″ for frame
2	2″ x 4″ x 3′6″ for frame
2	2″ x 4″ x 8′ for frame
2	2″ x 4″ x 7′ for guard rail
1	2″ x 4″ x 6′8″ for guard rail
6	1″ x 8″ x 8′ for back wall
26	1″ x 8″ x 7′ for floor and ends
13	1″ x 8″ x 8′ for roof

Hardware:

4 sheets galvanized roofing 2′ x 8″ for roof
5 pounds lead-head roofing nails for roof
5 pounds 10-penny nails
5 pounds 8-penny nails
3 pounds 20-penny nails

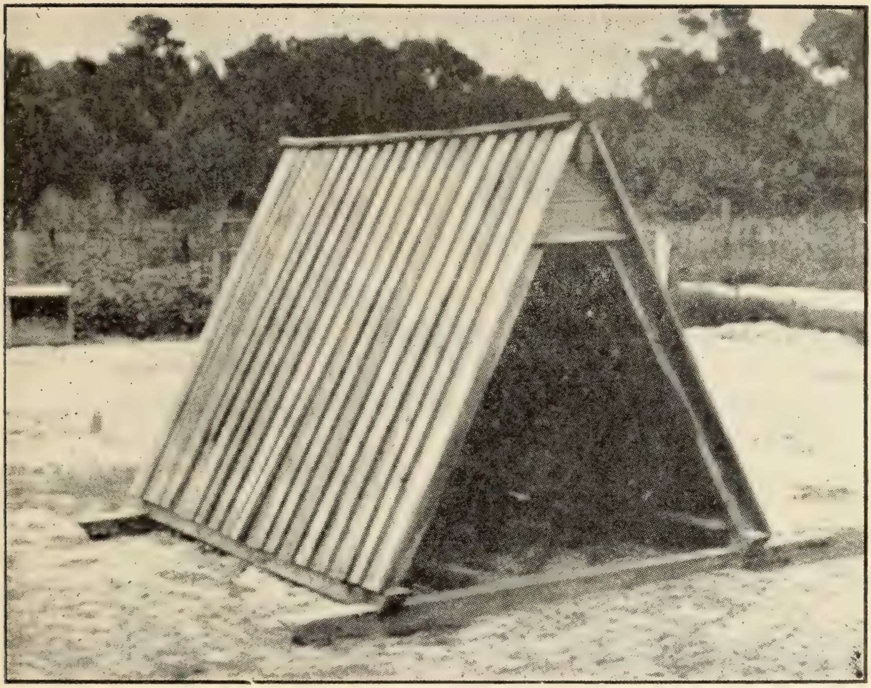

Figure 25. The A-shaped hog house is desirable for use with sow and pigs and grazing shoats.

BILL OF MATERIAL FOR IMPROVED A-TYPE HOUSE

No. pieces	Dimensions	Board feet
2	4″ x 4″ x 10′ for runners	28*
1	2″ x 6″ x 8′ to cover side doors	8
5	2″ x 4″ x 16′ for frame work and bracing	54
1	1″ x 12″ x 18′ for ridge	18
8	1″ x 12″ x 16′ for siding and doors	128
1	1″ x 12″ x 10′ for front door	10
6	1″ x 8″ x 16′ shiplap for ends	64
9	1″ x 6″ x 16′ rough fence planks for floor	72
16	1″ x 4″ x 16′ for bracing and slats	86
		468

*All board feet were figured to nearest even foot above actual number of feet when fractions of a foot resulted.

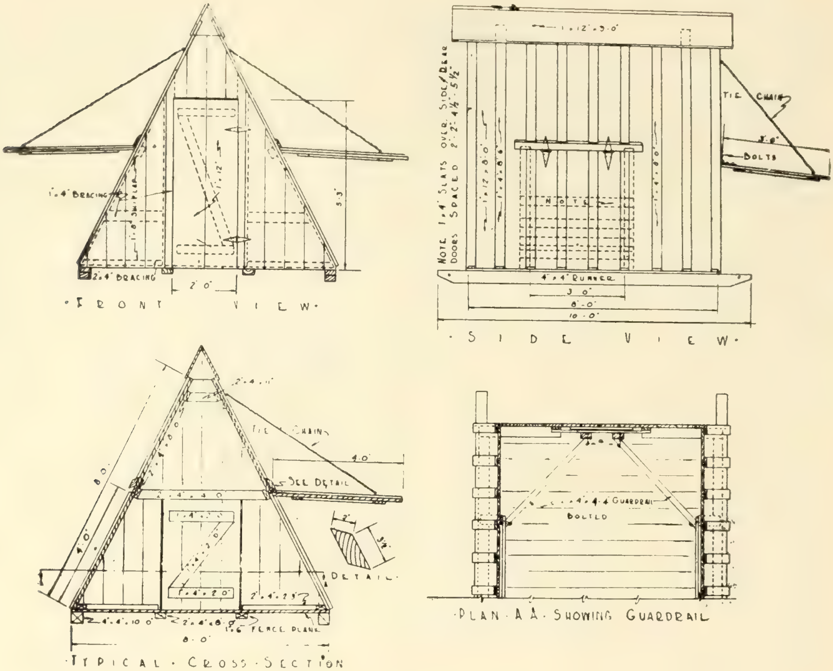
1" x 4" BRACING
2 x 4" BRACING
2' 0"
5' 3"
FRONT VIEW
1 x 12" x 3' 0"
NOTE 1 x 4" SLATS OVER SIDE/REAR DOORS SPACED 2" 2" 4½" 5½"
TIE CHAIN
BOLTS
4" x 4" RUNNER
3' 0"
8' 0"
10' 0"
SIDE VIEW
2 x 4 x 11"
TIE CHAIN
4' 0"
SEE DETAIL
2 x 4 x 4' 0"
8' 0"
4' 0"
DETAIL
1 x 4 x 2' 0"
2 x 4 x 2' 5"
4 x 4 x 10' 0"
2 x 4 x 8' 0"
1 x 6 FENCE PLANK
8' 0"
TYPICAL CROSS SECTION
4 x 4 GUARDRAIL
BOLTED
PLAN A A SHOWING GUARDRAIL

Figure 26. Improved "A" type house.

References: Agricultural Education, Volume 12, No. 4, December 1935, Clemson, South Carolina.

Florida Agricultural Experiment Station Bulletin 236, "Swine Production in Florida," June 1931, Gainesville, Florida.

Stocker or fattening hogs should be provided with protection from cold weather in winter and from the heat in the summer This protection may be afforded by the use of farrowing houses when not being used by sows, or by construction of separate houses for winter protection as illustrated in figure 27 and constructing a shade with brush or straw for summer protection if shade trees are not available as illustrated in figure 28.

Troughs are very important in feeding hogs. There are two general types of troughs, the V-type and the flat-botton. The V-type is usually preferred as a milk or slop trough and the fla-bottom is preferred as a water trough.

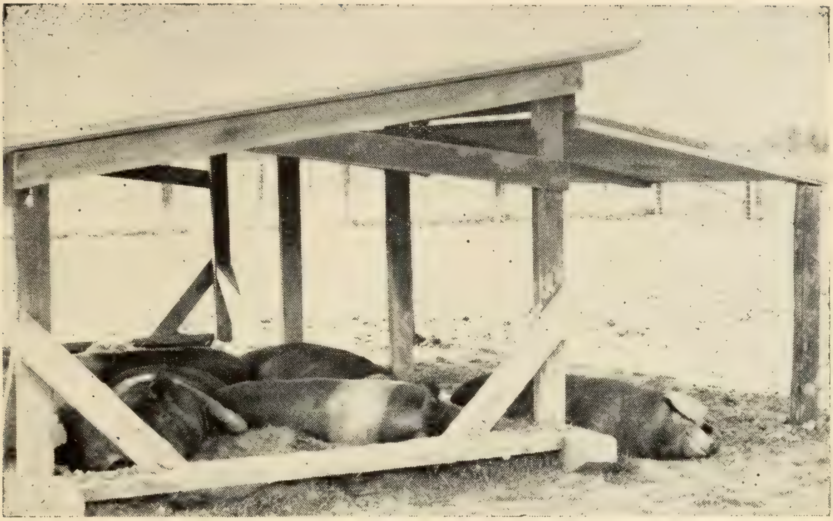

Figure 27. Combination movable winter and summer shade for hogs, with back raised in hot weather. With back let down and with one or both ends boarded up, this makes a good winter shed.

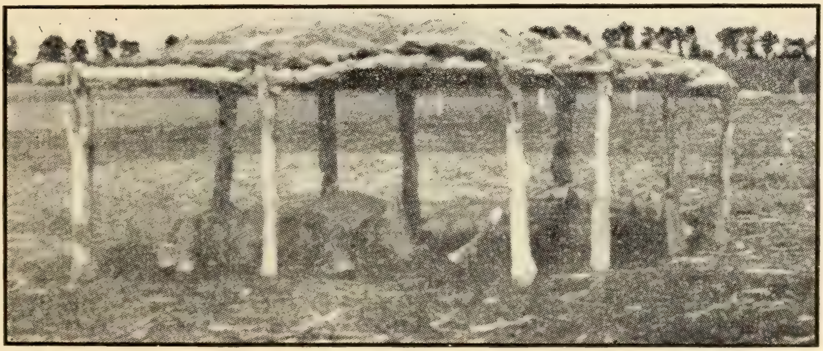

Figure 28. An economical shed for shade.

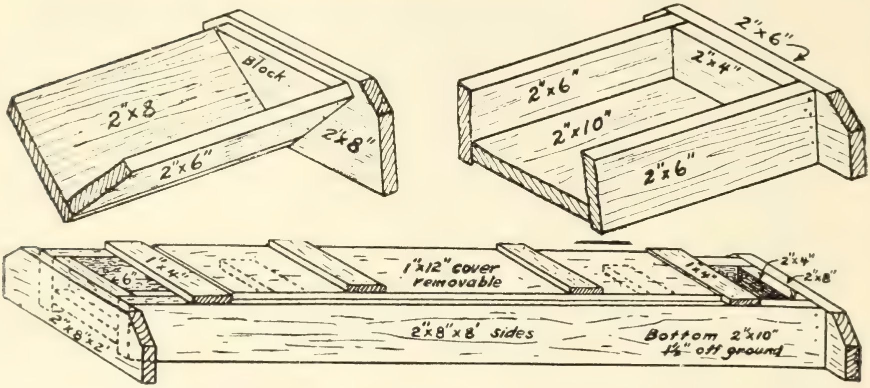
Block
2"x8
2"x8"
2"x6"
2"x6"
2"x4"
2"x6"
2"x10"
2"x6"
1"x12" cover removable
1"x4"
2"x6"
2"x8"x2'
2"x8"x8' sides
Bottom 2"x10" 1½" off ground
2"x4"
2"x8"

Figure 29. One end of V-shaped trough (left). One end of flat-bottom trough (right): Flat-bottom trough.

Pig Creeps: The use of pig creeps is very useful in feeding small pigs in that they are separated from the sows at feeding time. Creeps covered with wire will afford protection from chickens. The pig creep is illustrated in figure 30.

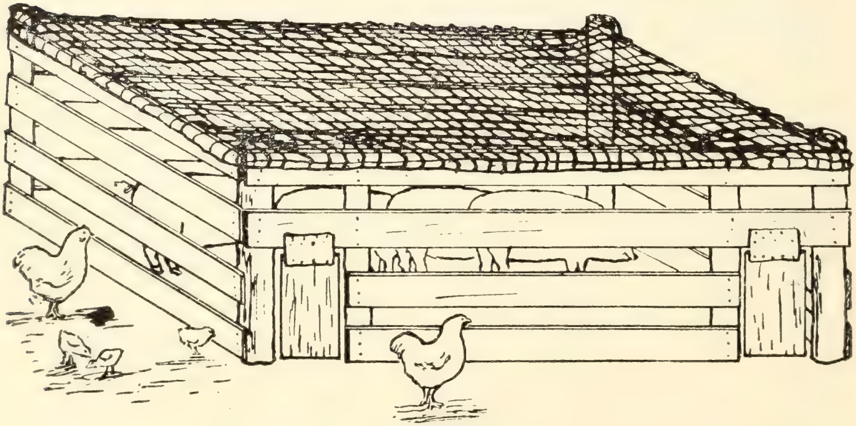

Figure 30. Wire-covered pig creep

Self-feeders: Self-feeders are used in many cases in feeding hogs. Self-feeders are great labor savers and render valuable service as a container in the field for protein supplements while crops are being hogged down. Feeders should be built on skids so that it may be moved from one place to another to prevent the formation of mud holes at the feeding place. Figures 31, 32 and 33 show the plan and material required in constructing two types of self-feeders.

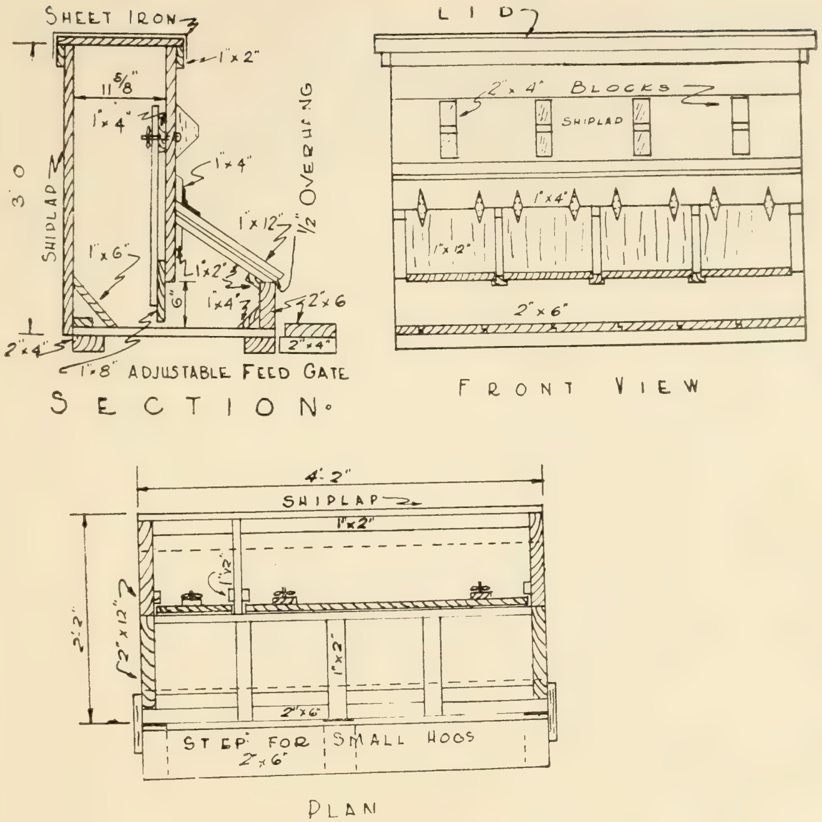
SHEET IRON
1"x2"
11 5/8"
1"x4"
1"x4"
3'0"
SHIPLAP
1/2" OVERHANG
1"x12"
1"x6"
1"x2"
6"
1"x4"
2"x6
2"x4"
2"x4"
1"x8" ADJUSTABLE FEED GATE
SECTION
LID
2"x4" BLOCKS
SHIPLAP
1"x4"
1"x12"
2"x6"
FRONT VIEW
4'-2"
SHIPLAP
1"x2"
1 1/2"
2'-2"
2"x12"
1"x2"
2"x6"
STEP FOR SMALL HOGS
2"x6"
PLAN

Figure 31. Improved self-feeder.

Reference: Agricultural Education, Volume 12, No. 4, December 1935. Clemson, South Carolina.

BILL OF MATERIALS FOR IMPROVED SELF-FEEDER

No. pieces	Dimensions	Board feet
1	½" x 2" x 14'	2
2	1" x 2" x 16'	6
1	1" x 2" x 12'	2
1	1" x 4" x 10'	4
1	1" x 8" x 4'	3
4	1" x 8" x 16' shiplap	44
1	1" x 12" x 14'	14
1	2" x 6" x 10'	10
1	2" x 12" x 8'	16
		101

Hardware:

4 pr. 4" strap hinges
1 pc. sheet iron 25" x 5' cut to 21" x 4'8"
3 ½" threaded wing nuts
Nails, 4-penny, 8-penny, and 16-penny

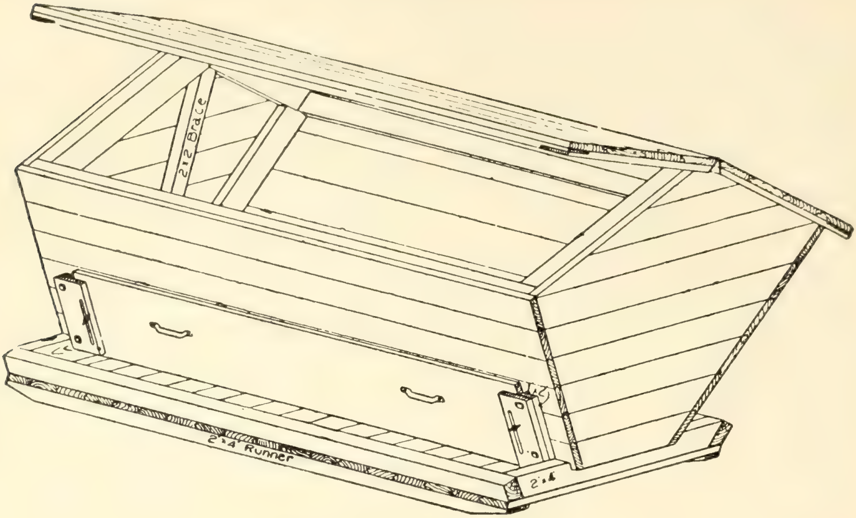

Figure 32. Two-way feeder.

BILL OF MATERIALS FOR TWO-WAY SELF-FEEDER

No. pieces	Dimensions
2	2″ x 4″ x 10′ framing for ends
2	2″ x 4″ x 12′ top frame and sides of feed trough
1	2″ x 4″ x 14′ runners
1	2″ x 4″ x 10′ ends of feed trough and center brace
13	1″ x 4″ x 12′ flooring for ends, side and floor
2	1″ x 4″ x 12′ for cleats and braces on top
1	1″ x 8″ x 12′ deflector boards
1	1″ x 10″ x 6′ adjustable slide
4	1″ x 8″ x 14′ shiplap for top
1	2″ x 3″ x 12′ support for deflector boards and for bracing

Hardware:

- 4 wing-nut bolts
- 1½ pair hinges
- Nails

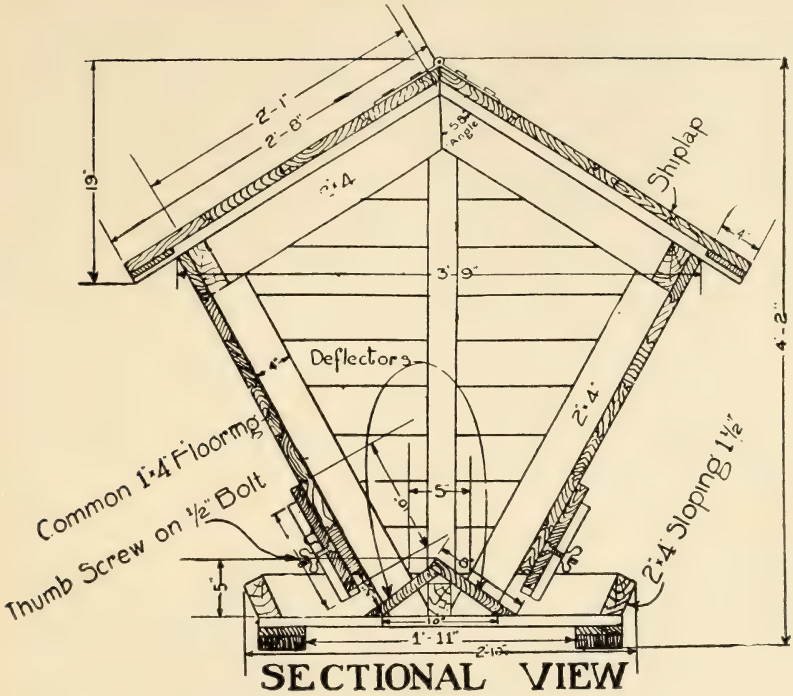
2'-1"
2'-8"
19"
58° Angle
2"x4"
Shiplap
4"
3'-9"
4'-2"
Deflectors
2"x4"
Common 1"x4" Flooring
Thumb Screw on ½" Bolt
2"x4" Sloping 1½"
5"
6"
5"
6"
10"
1'-11"
2'-10"
SECTIONAL VIEW

Figure 33. Cross-section of a two-way feeder.

The two-way feeder illustrated above is designed for feeding shelled corn and ground feed to a herd of 35 to 50 hogs. To feed a small number of hogs the size of the feeder may be reduced in proportion to the number of hogs to be fed.

Reference: Missouri Agricultural Experiment Station Bulletin 144, "Self-Feeders for Fattening Swine with Directions for Constructing a Self-Feeder" February 1917, Reprinted April 1920, Columbia, Missouri.

The arrangement of hog houses and feeding equipment is very important. Houses and feeding lots should be located in well drained places where plenty of sunshine is available. Feeding places should never be located in the shade of trees or in the houses provided for protection. Figure 14 page 35 illustrates a well planned feeding arrangement and pasture which may be very helpful in controlling disease and parasites.

PART IV

Care, Management, and Feeding of Brood Sow and Young Pigs

Profitable hog production is not possible unless a system of care and management is planned and operated. An important part of such a system is properly handling the sow and young pigs.

The time to start raising a litter of pigs is before the sow is bred. The sow should be in a medium condition, not too fat or too poor. Many hog producers breed the sow so as to get two litters of pigs per year. The following breeding dates are recommended by the Georgia Experiment Station for successful breeding of two litters per year:

April 20*—Start flushing sow for fall litter
May 1 to 10—Breed sow for fall litter
September 1—Farrow fall litter
October 20 to November 1—Wean fall litter
October 20*—Start flushing sows for spring litter
November 1 to 10—Breed the sow for spring litter
March 1—Farrow spring litter
April 20 to May 1—Wean spring litter

It is just as important not to over-feed the sows during the gestation period as it is to feed a well-balanced ration. Sows should not be allowed to become too fat or too thin during this period. A mature sow which is in thin, active condition at the beginning of the breeding season should be fed to gain 75 to 85 pounds by farrowing time. Most of this gain should be made during the last 4 or 6 weeks of the gestation period rather than during the first part, for most of the growth of a litter occurs then.

Plenty of clean fresh water should be furnished the brood sow and the supply should be conveniently accessible so that they will take enough for their body requirements.

Brood sows should always be supplied with salt, which may best be fed in a suitable box or self-feeder so they can get what they need. Iodized salt is preferable to common salt. In many cases rations fed are low in a calcium and phosphorus, making it necessary to supply the ration with these minerals. These minerals are very important in the ration of a brood sow.

An abundance of exercise during the gestation period is necessary if thrifty pigs are to be expected. Sows may be forced to exercise by feeding at a point quite a long ways from their sleeping quarters. By feeding ear corn, and making the proper allowances, sows will spend considerable time searching for the last kernels. This will keep the sow on her feet and is good for her health.

Care at farrowing time is very important. The sow should be separated from the rest of the herd at least three days before she is to farrow. The farrowing place should be sufficiently warm so that a deep nest is not necessary to prevent the newborn pigs being chilled, for they may be crushed in a deep bird-like nest. Cut straw or hay, chaff and leaves are the best for bedding. Every farrowing pen should be supplied with fenders to protect the little pigs during and after farrowing. These consist of 2" x 8" planks fastened as shelves about 8 inches from the floor along all sides of the farrowing pen.

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*Flushing is a practice of increasing the feed in order that the sow may be in good flesh or gaining in weight. This practice seems to stimulate the reproductive organs which results in most cases in producing larger litters.

A short time before farrowing the sow should be fed a mixture containing at least one-third by weight of wheat bran. Feed about the same volume of this mixture as the sow previously received. It will keep her satisfied and in a good laxative condition.

At birth, pigs have long sharp tusks and so far as is known are of no benefit to the pigs. On the other hand, they are apt to lacerate the udder of the sow and also to cut the other pigs as they tussle among themselves. Many hogmen remove these tusks close to the gums with nippers made for the purpose, as illustrated in figure 34. One should not injure the gums for such cuts make a very good place for infection to set in.

The sow should receive no feed for about 24 hours after farrowing, but she should be supplied with all the lukewarm water she will drink. After the first day she should be given a small amount of wheat bran and shorts or a mixture of bran, ground grain and a little tankage, gradually increasing the amount as her milk flow grows larger, until after 10 to 14 days she will be on a full ration. Many pigs are lost each year through feeding the sow too heavy during the first two weeks.

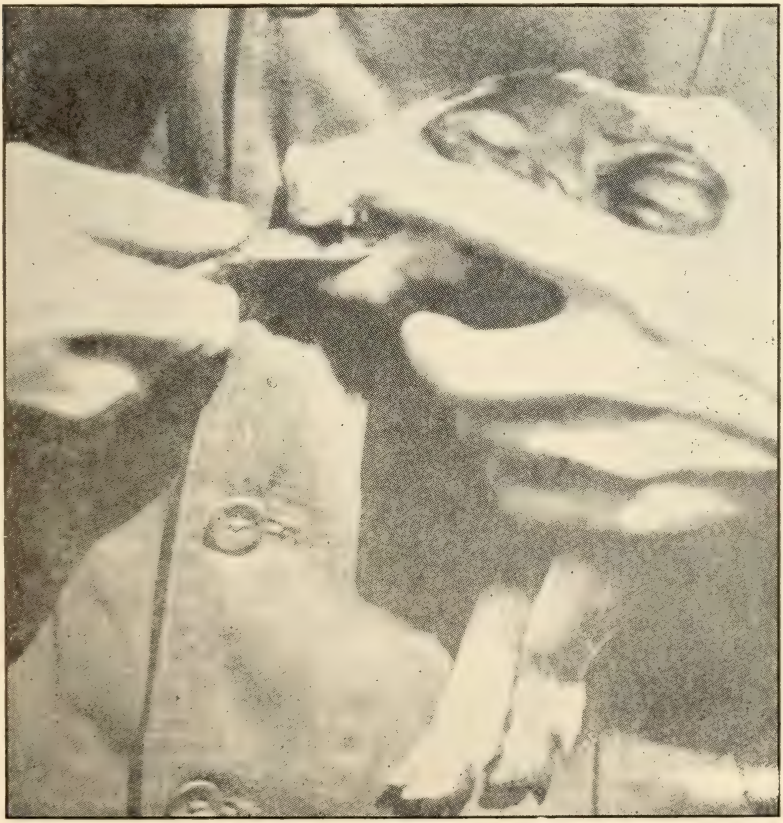

Figure 34. Removing temporary tusks.

Young pigs should be provided with plenty of exercise, especially when well fed, or a number are sure to die from thumps. This needed exercise may be provided by placing the sow and litter on pasture, being careful not to allow the young pigs out in the weather if cold or damp. Care should be taken to keep the lot and feeding pens sanitary.

References: Wisconsin Agricultural Experiment Station Bulletin 400, "Feed and Care of the Brood Sow and Litter," Madison, Wisconsin, July 1928.

Louisiana Extension Circular 144, "Care and Management of Hogs in Louisiana," Baton Rouge, Louisiana, Revised June 1935.

Pig Production Studies

The Indiana Agricultural Experiment Station has conducted experiments dealing with the problems (1) the effect of age of sows on productivity, and (2) the effect of weight at birth in the development of pigs from birth to weaning.

EFFECT OF AGE ON THE PRODUCTIVITY OF SOWS*

	Age of sows		
	1 year	2 years	3 to 5 years
Farrowing record			
Number of sows farrowed pigs	125.00	103.00	129.00
Number pigs farrowed per litter	7.78	8.38	10.46
Average weight of pigs farrowed	2.50	2.70	2.60
Percentage strong	63.70	70.76	65.81
Percentage born dead	4.96	4.91	6.54
Percentage died during suckling	42.26	27.46	34.40
Percentage weaned	60.83	67.62	60.21
Weaning record			
Number sows weaned pigs	117.00	99.00	126.00
Average number pigs in weaned litter	6.54	8.13	8.27
Average weight of litters weaned	125.96	189.33	180.77
Average weight of pigs weaned	23.50	28.29	27.85
Percentage strong	68.55	86.67	84.75
Percentage medium	25.18	10.15	12.29
Percentage weak	6.26	3.15	2.94

*Sows in Experimental Swine Farm Herd (1921-1934.)

THE EFFECT OF WEIGHT AT BIRTH ON THE DEVELOPMENT OF PIGS FROM BIRTH TO WEANING* (56 days)

Birth weight pounds	Number pigs farrowed	Percentage born dead	Percentage died during suckling	Percentage weaned	Average weaning weight pounds	Average daily gain during suckling pounds
1.00	56	46.43	53.57	.00	.00	.00
1.25	107	14.02	84.11	1.87	8.63	.13
1.50	270	15.93	71.11	12.96	18.42	.30
1.75	291	7.90	58.08	34.02	19.97	.33
2.00	674	6.08	44.66	49.26	20.91	.34
2.25	832	4.33	32.33	63.34	22.78	.37
2.50	1,531	4.38	28.22	67.40	24.49	.39
2.75	1,157	3.54	22.30	75.16	26.24	.42
3.00	1,354	4.14	18.54	77.32	27.50	.44
3.25	587	2.73	14.82	82.45	29.39	.47
3.50	426	3.05	11.27	85.68	30.22	.48
3.75	143	2.80	13.29	83.91	30.86	.48
4.00	93	1.08	15.05	83.87	34.72	.55
4.25	28	3.57	10.71	85.72	36.72	.58
4.50	2	.00	.00	100.00	30.00	.46
4.75	2	.00	.00	100.00	38.67	.61
Average	—	5.07	28.63	66.30	26.14	.42

*Litters in Experimental Swine Farm Herd (1921-1935.)

Reference: Indiana Agricultural Experiment Station Bulletin 412, "Feeding and Management Experiment with Brood Sows and Litters," Lafayette, Indiana, March 1938.

Method of Handling Sows and Young Pigs

Conducted by: Florida Agricultural Experiment Station.

Conducted at: Gainesville, Florida.

Procedure and Conditions: Records were kept of birth weights, and weekly weights were taken of individual pigs until they reached the feeder stage. There was found to be a significant difference in the rate of growth of spring and fall-farrowed pigs.

Results:

A COMPARISON OF SPRING AND FALL LITTERS

		Spring			Fall		
	Sow No.	No. pigs raised in litter	Av. wt. at birth	Av. wt. at 8 weeks	No. pigs raised in litter	Av. wt. at birth	Av. wt. at 8 weeks
Mature sows			Lbs.	Lbs		Lbs.	Lbs.
Duroc-Jersey	16	10	3.80	44.40	10	3.08	20.70
Poland China	33	3	4.17	52.27	5	3.22	29.72
Poland China	18	8	3.19	32.30	10	2.77	19.60
Poland China	122	8	3.01	29.81	7	2.81	25.57
Average	—	7.25	3.45	40.61	8	2.95	22.83
Gilts (first litter in spring, second in fall)							
Duroc-Jersey	24	9	2.61	30.97	10	2.92	27.61
Poland China	25	8	3.75	35.45	8	2.62	20.63
Poland China	36	7	2.40	25.00	8	2.43	19.40
Poland China	3	8	3.13	25.80	7	3.30	21.60
Poland China	29	6	3.00	28.60	7	2.74	24.40
Poland China	17	8	2.70	27.43	7	2.71	21.80
Average	—	7.67	2.93	29.02	7.83	2.78	22.79

Reference: Florida Agricultural Experiment Station 1939 Annual Report, pages 75 and 76, June 30, 1939, Gainesville, Florida.

The Effect of Rations and Management During Gestation

Conducted by: Purdue University Agricultural Experiment Station.

Conducted at: Experimental Swine Farm, Lafayette, Indiana.

Purpose: To determine the effect of rations, effect of exercise, and effect of condition during gestation.

The following comparisons were made:

1. Effect of rations during gestation
    - a. Shelled corn alone
    - b. Shelled corn 2/3 and whole oats 1/3 by weight
    - c. Shelled corn 2/3 and whole oats 1/3 by weight, plus 5 percent tankage in the ration*
2. Effect of exercise during gestation
    - a. Liberal exercise
    - b. Limited exercise
3. Effect of condition during gestation
    - a. Medium condition
    - b. Fat condition

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*Tankage increased to 8 percent for gilts during the last six weeks of gestation.

Procedure and Conditions: Only sows bred for spring farrow were used in the experiments. All the experiments were conducted on the Experimental Swine Farm, where a herd of fifty to sixty high grade Duroc-Jersey sows was available for the work. The herd was composed of approximately three-fifths mature sows and two-fifths spring gilts, when the experiments were started at breeding time in November. In all cases, the sows and gilts received well-balanced rations prior to starting the experiment.

The sows were fed in individual stalls, to control the condition of the sows for a study of the effect of medium and fat condition on their ability to farrow and raise pigs. The arrangement of lots was also different in the first five experiments. In these experiments, a study was made of the effect of exercise during gestation. It was necessary to confine some of the sows to small lots for limited exercise, while the others were forced to take liberal exercise by placing the sleeping quarters and the feeding floors at opposite ends of long lots. In the other experiments, all sows were forced to take exercise in the long lots; and all were fed for medium condition of flesh. The exercise lots were 30 feet wide by 30 rods long. The small lots, used for confinement of sows, measured approximately 30 by 40 feet.

The general procedure at farrowing time was to move the sows a few days prior to farrowing from their experimental lots to the central farrowing house. When the litter was approximately one to two weeks old, the sow and pigs were moved out to an individual house on either rye or timothy pasture. Timothy pasture was used in the earlier experiments and rye pasture in the later experiments. The sows and pigs were kept in the pasture lots during the suckling period. In the majority of the experiments, the experimental rations were discontinued at farrowing time and the lots received like rations during the suckling period. Measurement of results from feeding the different gestation rations was based on the number and strength of pigs farrowed, and the number of pigs weaned. In some of the experiments, the comparison of feeds was carried through both the gestation and suckling periods. In all cases, the sows and their litters were fed like rations. The sows were hand-fed, however, while the pigs were self-fed in open troughs. All pigs were weaned at 56 days of age, at which time they were finished in the experiments. The sows and their litters were divided into small groups during the suckling period. Each pasture lot contained from 2 to 4 sows and their litters. This arrangement saved pigs, and made it possible to keep accurate check on the litters.

Animals Used: The first experiment contained 18 mature sows. Each of the other experiments that followed contained 24 mature sows and 12 gilts. The sows and gilts in each experiment were divided into three equal groups for the ration comparison. Each of these groups was subdivided for the condition comparison. Further division was made in the various sub-groups for the exercise comparison.

The plan is presented in tabular form as follows:

RATION	CONDITION	EXERCISE
Group I—Corn alone 4 gilts, 8 sows	Sub-group A—medium 2 gilts, 4 sows	Lot 1—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 2—limited 1 gilt, 1 two year old sow, 1 older sow
	Sub-group B—fat 2 gilts, 4 sows	Lot 3—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 4—limited 1 gilt, 1 two year old sow, 1 older sow
Group II—Corn and oats 4 gilts, 8 sows	Sub-group C—medium 2 gilts, 4 sows	Lot 5—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 6—limited 1 gilt, 1 two year old sow, 1 older sow
	Sub-group D—limited 2 gilts, 4 sows	Lot 7—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 8—limited 1 gilt, 1 two year old sow, 1 older sow
Group III—Corn, oats and tankage 4 gilts, 8 sows	Sub-group E—medium 2 gilts, 4 sows	Lot 9—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 10—limited 1 gilt, 1 two year old sow, 1 older sow
	Sub-group F—fat 2 gilts, 4 sows	Lot 11—liberal 1 gilt, 1 two year old sow, 1 older sow
		Lot 12—limited 1 gilt, 1 two year old sow, 1 older sow

CONDITION OF SOWS DURING GESTATION AS AFFECTING LITTERS PRODUCED

	Average of five experiments														
	Sows in medium condition							Sows in fat condition							
Farrowing record	1	2	3	4	5	Total	Av.	1	2	3	4	5	Total	Av.
Number of litters	10	15	15	14	16	70	—	6	17	17	18	15	73	—
Total number of pigs	86	122	143	127	147	625	8.93	58	136	154	179	129	656	8.99
Average weight of pigs	2.33	2.40	2.79	2.67	2.81	—	2.63	2.53	2.36	2.52	2.54	2.87	—	2.56
Strong pigs	55	61	117	82	112	427	—	44	70	96	90	98	398	—
Medium pigs	18	35	12	27	20	112	—	6	41	27	56	14	144	—
Weak pigs	11	21	8	16	6	62	—	7	19	14	21	8	69	—
Dead pigs	12	5	6	2	9	24	—	1	6	17	12	9	45	—
Weaning record														
Number sows weaned pigs	10	14	15	14	16	69	—	6	16	12	17	15	66	—
Total number of pigs	61	92	91	76	111	431	6.25	39	74	66	94	88	361	5.47
Average weight of pigs	24.53	23.07	30.01	28.51	24.75	—	26.13	23.11	26.41	29.93	30.74	24.00	—	27.24
Strong pigs	51	66	86	67	89	359.0	—	25	61	56	84	62	288	—
Medium pigs	9	22	1	9	15	56	—	10	12	10	6	19	57	—
Weak pigs	1	4	4	0	7	16	—	4	1	0	4	7	16	—
	Sows receiving liberal exercise							Sows receiving limited exercise							
Farrowing record	1	2	3	4	5	Total	Av.	1	2	3	4	5	Total	Av.
Number of litters	8	18	18	16	16	76	—	8	14	14	16	15	67	—
Total number of pigs	73	130	163	158	136	660	8.68	71	128	134	148	140	621	9.27
Average weight of pigs	2.41	2.39	2.79	2.64	2.86	—	2.65	2.41	2.37	2.48	2.54	2.82	—	2.54
Strong pigs	53	68	129	93	100	443	—	46	63	84	79	110	382.0	—
Medium pigs	10	41	22	41	16	130	—	14	35	17	42	18	126.0	—
Weak pigs	8	17	5	18	11	59	—	10	23	17	19	3	72.0	—
Dead pigs	2	4	7	6	9	28	—	1	7	16	8	9	41.0	—
Weaning record														
Number sows weaned pigs	8	16	16	16	16	72	—	8	14	11	15	15	63	—
Total number of pigs	46	86	101	101	90	424	5.89	54	80	56	69	109	368	5.84
Average weight of pigs	24.68	24.78	29.70	28.93	24.60	—	24.89	23.37	24.31	30.47	30.47	24.27	—	26.34
Strong pigs	35	68	89	89	69	350	—	41	59	53	62	82	297	—
Medium pigs	11	14	9	9	12	55	—	8	20	2	6	22	58	—
Weak pigs	0	4	3	3	9	19	—	5	1	1	1	5	13	—

RESULTS:

EFFECT OF RATIONS AND MANAGEMENT DURING GESTATION.

Group	I				II				III			
Ration	Corn alone				Corn and oats				Corn, oats and tankage			
Sub-group	A		B		C		D		E		F	
Condition	Medium		Fat		Medium		Fat		Medium		Fat	
Lot	1	2	3	4	5	6	7	8	9	10	11	12
Exercise	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited
No. sows farrowed	13	8	13	12	12	11	12	13	13	13	13	10
No. sows weaned pigs	13	8	10	9	12	11	12	12	12	13	13	10
Av. weight when bred	366.77	358.62	358.15	353.58	364.58	335.00	350.42	361.69	359.23	338.38	341.85	373.40
Av. total gain during gestation	57.54	80.63	141.00	148.42	51.82	61.18	124.83	129.62	73.77	91.77	158.69	167.40
Av. daily gain during gestation	.50	.71	1.25	1.30	.46	.54	1.10	1.14	.65	.81	1.40	1.46
Av. daily feed during gestation	4.75	5.45	8.53	8.65	5.24	5.14	8.50	8.44	5.25	5.42	9.17	8.83
Av. daily feed per 100 lbs. live weight during gestation	1.20	1.34	1.96	1.98	1.33	1.40	2.04	1.96	1.33	1.41	2.15	1.93
Av. weight loss of farrow	30.92	33.00	37.69	39.36	33.75	35.09	36.75	32.62	31.00	32.62	35.92	36.20
Av. weight loss during suckling	41.31	28.00	56.62	88.38	30.45	40.64	56.91	65.00	38.75	51.54	81.00	52.00
Av. total loss in weight	72.23	61.00	94.31	127.74	64.20	95.73	93.66	97.62	69.75	84.16	116.92	88.20

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RESULTS:

EFFECT OF RATIONS AND MANAGEMENT DURING GESTATION.

Group	I				II				III			
Ration	Corn alone				Corn and oats				Corn, oats, and tankage			
Sub-group	A		B		C		D		E		F	
Condition	Medium		Fat		Medium		Fat		Medium		Fat	
Lot	1	2	3	4	5	6	7	8	9	10	11	12
Exercise	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited	Liberal	Limited
Breeding record*												
No. sows bred	14	14	13	13	14	14	13	13	14	14	13	13
No. sows settled	13	12	13	12	12	11	12	13	13	13	13	10
Farrowing record												
No. sows farrowed	13	8	13	12	12	11	12	13	13	13	13	10
Av. no. pigs in litter	7.85	9.50	8.69	9.42	8.75	9.45	9.50	9.69	8.69	9.54	8.69	9.00
Av. litter weight	22.06	25.84	21.38	21.90	22.79	22.89	24.44	22.10	23.73	24.10	23.58	25.38
Av. pig weight	2.81	2.72	2.46	2.33	2.60	2.42	2.57	2.54	2.73	2.55	2.71	2.80
Strong pigs, percent	68.63	69.74	54.87	74.29	74.29	51.92	62.28	68.14	69.91	75.00	73.45	65.55
Medium pigs, percent	22.55	17.11	25.66	25.66	12.38	28.85	26.32	19.47	16.81	11.29	14.16	20.00
Weak pigs, percent	5.88	7.89	13.27	18.58	9.52	16.35	6.14	9.73	7.96	10.48	10.62	3.33
Dead pigs, percent	2.94	5.26	6.19	15.04	3.81	2.88	5.26	2.65	5.31	3.22	1.77	11.11
No. sows raised pigs	13	8	10	9	12	11	12	12	12	13	13	10
No. sows lost all pigs	0	0	3	3	0	0	0	1	1	0	0	0
No. sows aborted	0	4	0	0	0	0	0	0	0	0	0	0
No. pigs per weaned litter	6.08	4.25	4.60	4.78	6.83	6.82	5.67	5.92	6.25	6.61	5.69	5.90
Av. litter weight	168.75	124.31	121.07	123.17	181.27	162.48	146.90	148.50	167.94	161.38	157.27	192.35
Av. pig weight	27.77	29.25	26.32	25.78	26.53	23.83	25.92	25.09	26.87	24.39	27.63	32.60
Strong pigs, percent	89.87	82.35	84.78	79.07	79.26	82.66	77.94	70.42	85.33	80.23	78.38	91.53
Medium pigs, percent	6.33	17.65	13.04	11.63	12.20	14.67	19.12	22.54	12.00	17.44	16.22	8.47
Weak pigs, percent	3.80	0.00	2.17	9.30	8.54	2.67	2.94	7.04	2.67	2.33	5.40	0.00
No. pigs weaned per sow farrowed	6.08	4.25	3.54	3.58	6.83	6.82	5.67	5.46	5.77	6.61	5.69	5.90
No. pigs weaned per sow bred	5.64	2.43	3.54	3.31	5.86	5.36	5.23	5.46	5.36	6.14	5.69	4.54
Percentage of pigs weaned	77.45	44.74	40.71	38.05	78.10	72.12	59.65	62.83	66.37	69.35	65.49	65.55

All sows and pigs had a ration composed of corn, wheat shorts, and tankage during the suckling period.

*Lots 1 and 2, 5 and 6, 9 and 10 each contained 10 sows and 4 gilts at breeding time.

Lots 3 and 4, 7 and 8, 11 and 12 each contained 9 sows and 4 gilts at breeding time.

Reference: Purdue University Agricultural Experiment Station Bulletin 413, "Feeding and Management Experiments with Sows and Litters," pages 3, 4, 5, 6, 7, 8, 9, 10, 14, and 15; tables 1, 2, 3, 4, 5, 6, 8 and 9, Lafayette, Indiana, May 1936.

Comparison of Corn Alone, Corn and Oats, and Corn with Oats and Tankage for Sows During Gestation

Conducted by: Purdue University Agricultural Experiment Station.

Conducted at: Experimental Swine Farm, Lafayette, Indiana.

Procedure and Conditions: High grade Duroc-Jersey sows bred for spring farrow were used in the experiment.

All sows were forced to take exercise in the long lots; and all were fed for medium condition of flesh. The exercise lots were 30 feet wide by 30 rods long. The small lots, used for confinement of sows, measured approximately 30 by 40 feet.

The general procedure at farrowing time was to move the sows from their experimental lots to the central farrowing house, a few days prior to farrowing. When the litter was approximately one to two weeks old, the sows and pigs were moved out to an individual house on either rye or timothy pasture. Timothy pasture was used in the earlier experiments and rye pasture in the later experiments. The sows and pigs were kept in the pasture lots during the suckling period. In the majority of the experiments, the experimental rations were discontinued at farrowing time, and the lots received like rations during the suckling period. Measurement of results from feeding the different gestation rations was based on the number and strength of pigs farrowed, and the number and strength of pigs weaned. In some of the experiments, the comparison of feeds was carried through both the gestation and suckling periods. In all cases, the sows and their litters were fed like rations. The sows were hand-fed, however, while the pigs were self-fed in open troughs. All pigs were weaned at 56 days of age, at which time they were finished in the experiments. The sows and their litters were divided into small groups during the suckling period. Each pasture lot contained from 2 to 4 sows and their litters. This arrangement saved pigs, and made it possible to keep accurate check on the litters.

The experimental rations were composed chiefly of home grown feeds. Yellow corn was used in all rations. In this test all sows and pigs had a ration composed of shelled corn 40 parts, ground corn 40 parts, wheat shorts 20 parts, and 60 percent tankage 10 parts. They also had a mineral mixture composed of wood ashes 10 parts, 16 percent superphoshate 10 parts, and com-

Results:

COMPARISON OF CORN ALONE, CORN AND OATS, AND CORN WITH OATS AND TANKAGE FOR SOWS DURING GESTATION

	Corn ⅔ whole oats ⅓ 60% tankage 1/20	Corn ⅔ whole oats ⅓	Corn alone
Amount of feed (lbs.)			
Corn	416	454	611
Oats	208	227	—
Tankage	32	—	—
Average number pigs per litter	10.7	9.1	8.7
Average weight per pig (lbs.)	2.56	2.65	2.52
Percent strong pigs	64.4	70.3	59.9
Percent dead pigs	8.4	5.5	8.9
Percent pigs reaching weaning age	72.9	73.4	66.2
Average gain per sow (lbs.)	55.3	53.8	59.6

Note: 23 mature sows bred; 22 mature sows settled; 1 sow died.

mon salt 1 part during the suckling period. The grain ration was hand-fed to the sows and self-fed to the pigs. The mineral mixture was self-fed in all lots.

Reference: Purdue University Agricultural Experiment Station Bulletin 413, "Feeding and Management Experiments with Brood Sows," pages 3, 4, 5, 12, and 16, tables 10 and 11, Lafayette, Indiana, March 1938.

Temporary Winter Pastures for Brood Sow

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Jeanerette Station, Jeanerette, Louisiana.

Period: February 1 to April 19, 1936.

Purpose: To determine the value of wintering brood sows on various pastures.

Procedure and Conditions: Winter oats, winter legumes and winter cereals were compared as a pasture for brood sows. The sows in the dry Bermuda lot were practically under dry lot conditions, but one-half acre of Bermuda sod was available for exercise and there was a limited amount of grazing.

Results:

WINTER PASTURES FOR BROOD SOWS

	Winter oats	Winter legumes	Winter cereals	Dry Bermuda (limited)
	Lot 1	Lot 2	Lot 3	Lot 4
Number of sows	5	5	5	5
Average initial weight (lbs.)	303	303	302	298
Average final weight (lbs.)	366	349	361	337
Average gain (lbs.)	63	46	59	39
Average daily gain (lbs.)	.94	.71	.89	.55
Average daily feed:				
Rice bran (lbs.)	1.85	1.88	1.83	3.07
Corn (lbs.)	.93	.94	.92	1.53
Protein mixture (lbs.)	.19	.19	.18	.31
Total	2.94	3.01	2.93	4.91

Rates of seeding were as follows: Lot 1, 2 bushels winter oats per acre; Lot 2, 30 pounds Austrian winter peas, 30 pounds Canadian peas, and 15 pounds hairy vetch per acre; Lot 3, 1½ bushels winter oats, ½ bushel winter barley, and 10 pounds Italian rye grass per acre.

Reference: Louisiana Agricultural Experiment Station Bulletin 303, "Pork Production," pages 16 and 17, table 6, Baton Rouge, Louisiana, November 1938.

Pastures for Sows and Young Pigs

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: April 3 to May 9, 1933.

Purpose: To compare white clover pasture, winter oats and rape, and alfalfa pasture for sows and pigs.

Procedure and Conditions: The experiment started when the pigs were about 3 weeks of age and ended at weaning time at 8 weeks of age.

Results:

PASTURES FOR SOWS AND SUCKLING PIGS

	Dry lot	Legume pasture clover or alfalfa	Oats and rape
Number of sows and litters	2	3	3
Number of pigs	14	24	21
Acres of pasture	—	1.5	1
Average weight of sows, April 3 (lbs.)	353.5	440.0	395.0
Average weight of sows, May 9 (lbs.)	319.5	412.0	357.0
Average loss in weight (lbs.)	34.0	28.0	38.0
Total weight of pigs, April 3 (lbs.)	144.0	249.0	192.0
Total weight of pigs, May 9 (lbs.)	437.0	877.0	712.0
Total gain of pigs (lbs.)	293.0	628.0	520.0
Average gain per pig (lbs.)	20.9	26.2	24.9
Gain per pig per day (lbs.)	.57	.73	.69
Net gain, sow and litter (lbs.)	225.0	545.0	406.0
Average gain per sow and litter (lbs.)	112.5	181.7	135.0
Feed per sow and litter (lbs.)	583.5	486.3	470.6
Pounds feed per 100 pounds gain	518.6	268.4	347.7

Reference: Louisiana Agricultural Experiment Station Bulletin 303, "Pork Production," pages 15 and 16, table 5, Baton Rouge, Louisiana, November 1938.

Effect of Age of Pigs on the Rate and Economy of Gains

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: 1916-1917.

Purpose: To study the effect of age or weight of pigs full-fed in dry lot, on rate of gain, the amount of feed consumed per unit of increase in weight, the character of the gain produced, and to obtain information relative to the factors influencing the weight at which pigs that are full-fed from birth should be slaughtered.

Procedure and Conditions: Pigs Used: Purebred Duroc-Jersey barrows from related dams were used. Those with the least possible difference in weight, age, thrift and uniformity were chosen for the experiments.

Quarters: Until the individual feeding was started in the first two experiments, the pigs were housed in "A" houses and allowed to run on a small bluegrass plot. During the day their dams were turned out on a larger area of bluegrass. While fed individually the pigs were kept in two 10 by 12 feet pens of a central house having a concrete floor. Wooden over-lays on which the pigs slept were provided during the winter. They were also allowed the run of a small dry lot in which the feed troughs were located. The quarters were cleaned daily. A small amount of straw was used for bedding.

Weighing: The pigs were weighed weekly. Their first weights were taken the day after they were farrowed. When the individual feeding was started the weighing time was changed to the same day of the week for all the pigs. The weights were taken just after noon. Care was taken to have the conditions at the time of weighing as nearly normal as possible. On weight-taking days, water was withheld from 10 A. M. until after weighing.

Feeding: The pigs were fed twice daily at regular hours. The amount fed was determined by what each pig would clean up readily and without waste. All proportions were determined by weight. The feeds were mixed dry. The daily feed for each pig was weighed out into morning and evening portions and just before feeding was mixed with sufficient water to thoroughly moisten it; during cold weather warm water was used. With the exception noted, drinking water was kept before the pigs at all times.

Feeds Used: Feeds used in this experiment were ground corn, tankage, linseed meal, middlings, and skim milk. The pigs were not fed all these feeds at one time. During the suckling period different combinations of these feeds were used. Some received corn, linseed meal and tankage while others received corn middlings, and tankage, supplemented with skim milk. The results of the different rations were not tabulated separately. The main rations consisted of ground corn, middlings and tankage.

Results:

EFFECT OF WEIGHT ON RATE AND ECONOMY OF GAINS

	From birth to 100 lbs. in weight	100 lbs. to 200 lbs. in weight	200 lbs. to 300 lbs. in weight	300 lbs. to 400 lbs. in weight	400 lbs. to 500 lbs. in weight
Number of pigs	37	30	23	16	7
Average no. days required	137.33	59.20	54.27	57.66	65.83
Average initial weight	2.65	100.39	201.53	301.50	402.02
Average final weight	100.25	200.95	299.93	398.79	504.64
Total gain per pig	97.64	100.58	98.40	97.30	102.61
Average daily gain	.80	1.69	1.82	1.37	15.71
Total feed per pig	296.73	360.59	408.79	457.51	524.09
Daily feed per pig	2.15	6.09	7.55	7.99	8.00
Feed daily per 100 lbs. wt.	4.21	4.04	3.01	2.28	1.76
Feed per 100 lbs. gain	304.1	358.8	414.5	410.03	510.10
Number killed	7.0	7.0	7.0	9.0	7.0
Average dressing percent	76.86	82.42	85.59	87.56	87.69

The above tabulation is an average of three separate experiments conducted at the Ohio Agricultural Experiment Station. Experiment 1 was conducted in 1916 using spring pigs. Experiment 2 was conducted in the fall of 1916 using fall pigs in this experiment. Experiment 3 was conducted in the fall of 1917 using fall pigs in the experiment.

Reference: Ohio Agricultural Experiment Station Bulletin 335, "Effect of Age of Pigs on the Rate and Economy of Gains," pages 545, 546, 548, and 550, tables 2, 3, and 5, Wooster, Ohio, March 1919.

Value of Fall Sown Rape Pasture for Pigs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: January 6 to March 28, 81 days.
March 28 to April 18, 21 days.

Purpose: To determine the value of fall sown rape pasture for pigs.

Procedure and Conditions: Dwarf Essex rape sown in drills on sandy upland, October 13, 1900, was ready for pasturage January 6, 1901, when four pigs, weaned about three weeks before, were confined on it with hurdles which were moved about once a week. The first growth of rape afforded pasturage until March 28. The second growth, on land previously grazed over, afforded pasturage from March 28 to April 18.

Throughout the whole period that the pigs were on rape they received also about a half ration of corn meal. Less rapid and more expensive gains were made in March, when the plants had become tough and ready to seed, than during January and February. The most rapid and economical growth was made during the brief period, while the succulent second growth was being consumed.

March 28, the rape having begun to blossom and having become relatively unpalatable, the hurdles were placed about the rape grazed in January and part of February, on which the second growth was by this time in good condition for pasturage, though small.

Results:

FALL SOWN RAPE PASTURE FOR PIGS

	Rape pasture	
	First growth	Second growth
Number of pigs	4.00	4.000
Total gain (lbs.)	181.00	82.000
Total gain per acre (lbs.)	567.00	491.000
Gain per day per pig (lbs.)	.558	.976
Acres per pig for period grazed	.080	.042
Feed consumed		
Rape pasture	.319	.167
Corn meal (lbs.)	524.00	168.000

Reference: Alabama Agricultural Experiment Station Bulletin 122, "Grazing and Feeding Experiments with Pigs," pages 12 and 13, Auburn, Alabama, January 1903.

To Compare Rations for Weanling Pigs on Dry Lot and Pasture

Conducted by: Missouri Agricultural Experiment Station.

Conducted at: Columbia, Missouri

Purpose: To determine whether any dry lot ration would give as good results as a ration containing green foliage.

Procedure and Conditions: The hogs in lots I, II and III (dry lots) were fed 105 days while those in lot IV (on pasture) were on experiment 112 days. A mineral mixture composed of equal parts of ground limestone, bonemeal and salt was self-fed to all lots except lot I in which case the mineral was a part of the mixed supplementary concentrate. Shelled yellow corn was fed all lots. Lots I, II and III were self-fed corn and supplemented free choice while IV was full-fed by hand twice daily.

The rations were as follows:

Lot I	**Lot II**	**Lot III**	**Lot IV**
Dry lot	Dry lot	Dry lot	Rape and oats pasture
Corn	Corn	Corn	(Corn 12)
Mixed concentrate*	Milk	(Tank. 60)	(Tank. 1)
Milk		(L.O.M. 15)	
		(Alf.M. 10)	
		(C.S.M. 15)	

*Corn 67.5%, liver meal 15%, dried buttermilk 10%, Alfalfa meal 5%, mineral (equal parts ground bonemeal and salt) 2.5%.

Results:

RATIONS FOR WEANING PIGS IN DRY LOT AND PASTURE

	Lot I	Lot II	Lot III	Lot IV
Average initial weight (lbs)	31.7	32.3	31.9	36.06
Average final weight (lbs.)	177.14	146.07	131.18	174.00
Average daily gain per head (lbs.)	1.33	1.09	.87	1.23
Average daily feed (lbs.)	3.68	2.62	—	—
Per head (lbs.)	6.44**	6.12**	3.08	4.2
Feed per 100 lbs. gain (lbs.)				
Corn	276.08***	239.16	270.51	314.87
Supplement	483.20**	559.60**	83.03	26.24
Total			353.54	341.11

**Milk.

***Corn plus mixed concentrate.

Reference: Missouri Agricultural Experiment Station Bulletin 376, "Rations for Weanling Pigs," pages 4 and 5, table 2, Columbia, Missouri, January 1937.

Rations for Weanling Pigs

Conducted by: Missouri Agricultural Experiment Station.

Conducted at: Columbia, Missouri.

Period: 112 days in summer 1930.

Procedure and Conditions: During the summer of 1930, 5 lots of 10 weanling pigs each were self-fed shelled corn (yellow or mixed, usually yellow) in dry lot. Two different mixtures of feeds were used to furnish the protein needed to balance the corn consumed.

Supplement "A" consisted of equal parts of tankage, linseed oil meal, fish meal, liver meal, dried skim milk and alfalfa meal. The mixture contained 40 to 45 percent protein.

Supplement "B" was made up of tankage 3 parts, linseed oil meal 1 part, and alfalfa meal 1 part, and contained about the same percentage of protein as supplement "A."

It will be noticed that there were three feeds in supplement "A," not found in supplement "B" viz, fish meal, dried skim milk and liver meal, previous experiments having indicated that each of these feeds was especially valuable in rations for young pigs. Corn was placed in one compartment of the feeder and the mixed supplement in another so the hogs could choose between the carbohydrous and nitrogenous concentrates.

All lots were self-fed a mineral mixture of equal parts precipitated calcium carbonate, decalcium phosphate, and salt. The nitrogenous supplements were fed to the various lots as follows:

	Supplement "A"	Supplement "B"
Lot I	First 28 days	Last 74 days
Lot II	First 56 days	Last 56 days
Lot III	First 74 days	Last 28 days
Lot IV	Entire period (112 days)	
Lot V		Entire period (112 days)

Results:

RATIONS FOR WEANLING PIGS

10 pigs per lot	Lot I	Lot II	Lot III	Lot IV	Lot V
Av. initial weight (lbs.)	30.9	30.7	30.9	30.9	31.1
Av. final weight (lbs.)	208.13	209.40*	198.40	218.8	195.78
Av. daily gain per head (lbs.)	1.58	1.56	1.50	1.66	1.47
Av. daily feed per head (lbs.)	5.27	5.38	4.91	5.50	4.76
Feed per 100 lbs. gain (lbs.)					
Corn	278.05	273.31	258.03	267.03	265.51
Supplement "A"	19.07	36.09	59.76	64.33	——
Supplement "B"	35.83	23.92	10.50	——	58.38
Total	332.95	333.32	328.29	331.36	323.89

*Average nine pigs only; one pig removed from this lot October 16 because of not doing well. It was posted by the Veterinary Department and found to be affected with necroenteritis. The entire record of this pig was eliminated from the data.

Reference: Missouri Agricultural Experiment Station Bulletin 376. "Rations for Weanling Pigs," pages 5 and 6, table 3. Columbia, Missouri, January 1937.

Self-feeding Compared with Hand-feeding Sows and Litters During Suckling Period

Conducted by: United States Experiment Farm.

Conducted at: Beltsville, Maryland.

Period: 1921 and 1922.

Purpose: To compare self-fed with hand-fed sows and litters during the suckling period.

Procedure and Conditions: In this experiment the following breeds were used: Duroc-Jersey, Poland China, Chester White, Hampshire, Tamworth, and Berkshire. In addition to these some grade sows and litters were on test. In most of the tests, pastures of various kinds were used. Pastures were usually rye, but a mixture of oats and some native grasses was used.

In the self-fed lots, certain feeds were constantly accessible in self-feeders to the sows and pigs during the entire period. The sows and pigs in the hand-fed lots were given twice daily all they would readily eat of identically the same feeds used in the self-fed lots. In the hand-fed lots, the young pigs had access to self-feeders placed in creeps providing supplementary feed after they had reached three weeks of age. Corn alone was provided in the self-feeders for the young pigs for the first two or three weeks. After this time the protein feeds were added.

Results:

SELF-FEEDING COMPARED WITH HAND-FEEDING SOWS AND LITTERS DURING SUCKLING PERIOD

	Hand-fed	Self-fed
Total number of lots on test	7	3
Total number of sows with litters	55	22
Average duration of test (days)	41	44.33
Initial number of pigs per sow	6.5	7.1
Final number of pigs per sow	6.2	6.9
Average age of pigs at start of test (days)	29.62	31.73
Average initial weight of sows (lbs.)	338.58	320.73
Average final weight of sows (lbs.)	351.35	309.14
Average gain or loss per sow (lbs.)	21.77	—11.59
Average daily gain or loss per sow (lbs.)	0.32	—0.26
Average initial weight of pigs (lbs.)	13.22	12.59
Average final weight of pigs (lbs.)	33.60	30.60
Average gain per pig (lbs.)	20.38	17.01
Average daily gain per pig (lbs.)	.51	.39
Pork produced per sow and litter (lbs.)	145.45	109.00
Feed consumed per sow and litter (lbs.)	641.54	657.36
Corn (lbs.)	531.58	436.68
Middlings (lbs.)	46.38	174.18
Tankage (lbs.)	78.76	44.68
Mineral mixture (lbs.)	2.82	1.82
Feed per 100 lbs. gain (sow and litter) (lbs.)	441.06	603.09
Corn (lbs.)	353.09	400.63
Middlings (lbs.)	31.88	159.80
Tankage (lbs.)	54.15	40.99
Mineral mixture (lbs.)	1.94	1.67

Reference: U. S. Department of Agriculture Farmers' Bulletin 1504, "Self-Feeding Versus Hand-Feeding Sows and Litters," pages 2 and 3, table 1, August 1926.

PART V

Feeding Pigs Through the Fattening Period

In this section consideration is given to the feeding of young pigs after the weaning period, through the fattening period. After pigs have passed the weaning stage a well planned feeding program is one of the most important factors of successful pork production.

In setting up a feeding program, consideration should be given to several points of feeding. Points that should be considered are: (1) carbohydrate feeds, (2) protein supplements, (3) mineral supplements, (4) soiling crops, (5) permanent pastures, (6) temporary pastures and feed preparation and methods of feeding. After careful consideration is given to these points a well planned hog feeding program should result.

Carbohydrate Feeds for Fattening Hogs

Carbohydrates are composed of carbon, hydrogen and oxygen with the ratio of hydrogen to oxygen the same as in water. Carbohydrate feeds commonly used in feeding hogs are: corn, small grains, seeds of legumes, and potatoes.

Carbohydrates are primarily fat and energy producing nutrients. These nutrients are stored in the grain by the plant and the hog utilizes the stored nutrients. Hogs require large amounts of carbohydrate feeds during the fattening period, especially if they are to make satisfactory gains.

Corn is an important carhohydrate feed, and often when hog feeding is discussed corn is the main feed considered, and is often the only feed given hogs. Corn alone does not contain sufficient quality, quantities, and right proportions of all the food elements to supply the needs of hogs if they are to make satisfactory gains. There are other carbohydrate feeds that may compare favorably with corn as a hog feed. All carbohydrate feeds should be considered, along with the economy of their production, before deciding which feed or feeds to use.

Substitutes for Corn for Growing and Fattening Pigs

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: From 1920s up to 1930s.

Purpose: To secure information on various feeds as complete or partial substitutes for corn in swine feeding.

Procedure and Conditions: In the tabulation given below a number of experiments conducted at the Ohio Agricultural Experiment Station are summarized. They were conducted over a considerable period of time, beginning in the 1920s and running up into the 1930s. The pigs were not fed in the same way throughout the different experiments; some were self-fed and others were hand-fed. All experiments were conducted in dry lots.

Results:

SUBSTITUTES FOR CORN FOR GROWING AND FATTENING PIGS

		Complete Substitute					Partial Substitute		
	Corn	White hominy feed	Yellow hominy feed	Barley	Oats	Ground hulled oats	Corn, ground oats	Ground corn, ground hulled oats	Corn, wheat middlings
	Supplement	Supplement	Supplement	Supplement	Supplement	Supplement	Supplement	Supplement	Supplement
Number of comparisons	25	5	2	5	8	7	6	4	4
Pigs at start	226	58	29	45	75	50	61	38	28
Initial wt. per pig (lbs.)	54.4	57	54.5	55.8	53	50.9	58	58.7	77
Pigs at close of test	54	55	26	45	73	44	60	37	27
Final wt. per pig (lbs.)	199.1	194.	200.5	204.4	199.0	202.0	204.0	201.3	211.9
Average daily gain (lbs.)	1.17	1.20	1.13	1.12	.96	1.19	1.14	1.15	1.25
Days required to gain 160 lbs.	138.	134.	141.	143.	167	135.	141.	140.	128.
Daily feed per pig (lbs.)									
Corn	3.95	—	—	—	—	—	3.13	3.04	3.92
White hominy feed	—	4.23	—	—	—	—	—	—	—
Yellow hominy feed	—	—	3.85	—	—	—	—	—	—
Wheat middlings	—	—	—	—	—	—	—	—	1.03
Barley	—	—	—	4.09	—	—	—	—	—
Oats	—	—	—	—	4.35	—	1.08	—	—
Ground hulled oats	—	—	—	—	—	3.57	—	.85	—
Tankage	.37	.31	.28	1.22	.18	.16	.39	.36	.29
Linseed meal	.11	.06	.14	.08	.05	.05	.12	.09	—
Ground alfalfa	.11	.06	.15	.09	.12	.11	.15	.14	.02
Minerals	.06	.05	.05	.04	.06	.06	.07	.07	.02
Total	4.60	4.71	4.48	4.52	4.76	3.95	4.94	4.55	5.28
Feed per 100 lbs. gain (lbs.)									
Corn	338.53	—	—	—	—	—	274.92	264.88	312.79
White hominy feed	—	352.22	—	—	—	—	—	—	—
Yellow hominy feed	—	—	339.09	—	—	—	—	—	—
Wheat middlings	—	—	—	—	—	—	—	—	82.04
Barley	—	—	—	366.26	—	—	—	—	—
Oats	—	—	—	—	453.10	—	94.96	—	—
Ground hulled oats	—	—	—	—	—	300.70	—	73.65	—
Tankage	31.73	26.03	24.65	20.22	18.65	13.50	39.79	31.16	22.69
Linseed meal	9.66	5.17	12.33	6.92	5.23	3.73	10.33	8.16	—
Ground alfalfa	9.67	5.20	12.88	7.76	12.83	9.50	12.99	11.87	1.75
Minerals	5.06	3.66	4.86	3.36	6.01	4.97	6.34	5.88	1.60
Total	394.68	392.28	393.82	404.52	495.82	332.40	433.13	395.60	420.87

Reference: Ohio Agricultural Experiment Station Bulletin 607, "Substitutes for Corn for Growing and Fattening Pigs," pages 5, 7, 15, 17, 19, and 29, tables 1, 2, 7, 8, 9, and 16, Wooster, Ohio, September 1939.

Feeding Tests with Velvet Beans

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Purpose: To determine the value of velvet beans in the ration for hogs.

Procedure and Conditions: Five groups of pigs were fed the following rations:

Lot 1
Shelled corn
Digester tankage
Mineral Mixture
Self-fed, free choice

Lot 2
Mixture of 50% shelled corn and 50% velvet beans
Ground digester tankage
Mineral mixture
Self-fed, free choice

Lot 3
Shelled velvet beans
Digester tankage
Mineral mixture

Lot 4
Shelled velvet beans
Mineral mixture
Self-fed, free choice

Lot 5
Shelled and cooked velvet beans
Mineral mixture
Self-fed, free choice

Results:

VELVET BEAN FEEDING TEST

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Av. gain per animal	214.4	181.9	88.6	55.8	120.7
Av. feed consumption per animal					
Corn (lbs.)	959.8	397.9	—	—	—
Velvet beans (lbs.)	—	397.9	362.2	261.4	505.7
Tankage (lbs)	30.0	81.1	161.0	—	—
Mineral mixture (lbs.)	1.2	1.4	3.9	3.6	4.4
Av. grading for fat hardening	Hard	Medium hard	Medium soft	Medium soft	Medium hard

Reference: Georgia Agricultural Experiment Station Circular 84, "Swine Feeding and Quality of Pork," page 2, Experiment, Georgia, March 1929.

Peanuts for Fattening Hogs in Dry Lot

Conducted by: Alabama Agricultural Experiment Station.

Conducted: On the farm of Parke Thompson, Goshen, Alabama.

Period: 1921-1923.

Purpose: To determine the amount of picked runner peanuts required to produce 100 pounds of gain on fattening hogs in the dry lot.

To compare the relative feeding value of runner peanuts alone; peanuts and corn; peanuts and tankage; and peanuts, corn and tankage.

To test the influence of the above rations on the quality of the carcass.

Procedure and Conditions:

Animals Used: All hogs were purebred Poland China of the large type.

Rations: The following rations were fed:

Lot 1—Runner peaunts, self-fed
Lot 2—Runner peanuts
Shelled corn
Free choice

Lot 3—Runner peanuts
60 percent tankage
Free choice
Lot 4—Runner peanuts
Shelled corn
60 percent tankage
Free choice

The hogs had access at all times to water and to a simple mineral mixture composed of equal parts by weight of air-slaked lime, salt, and charcoal.

Results:

PEANUTS FOR FATTENING HOGS IN DRY LOT

	Lot 1	Lot 2	Lot 3	Lot 4
Number of hogs to lot	6	6	6	6
	Lbs.	Lbs.	Lbs.	Lbs.
Average initial weight	104.0	105.1	103.9	104.9
Average final weight	259.2	249.8	271.3	268.6
Average daily gain per hog	2.03	1.92	3.30	2.17
Average daily feed per hog				
Runner peanuts	7.39	4.57	7.76	5.65
Shelled corn	—	3.29	—	2.48
60% tankage	—	—	.22	.15
Total	7.39	7.86	7.98	8.28
Feed for 100 pounds gain				
Runner peanuts	361.83	245.0	351.30	264.41
Shelled corn	—	165.9	—	112.66
60% tankage	—	—	11.06	7.30
Total	361.83	410.9	362.36	384.37

Unfortunately, a record of the amount of mineral mixture consumed was not kept in any of these experiments.

The hogs in experiment 1 were slaughtered at the plant of Swift and Company, Andalusia, Alabama. All carcasses were soft or oily.

The hogs from the second experiment were slaughtered at the plant of the Birmingham Packing Company, Birmingham, Alabama. All carcasses were soft or oily. The carcasses of lots 1 and 3 appeared somewhat softer than those of lots 2 and 4 but there was not enough difference to affect the commercial value.

Hogs in experiment 3 were sold to a local dealer. Slaughter data were not obtained, as the results of the two former experiments showed that these rations produced soft or oily carcasses.

Reference: Alabama Agricultural Experiment Station Bulletin 223, "Peanuts for Fattening Hogs in the Dry Lot," pages 2, 3, 4, 5, and 6, tables 1, 2, and 3, Auburn, Alabama, June 1924.

Sweetpotatoes As a Feed for Swine

Conducted by: Georgia Agricultural Experiment Station.
Conducted at: Experiment, Georgia.
Period: Test 1—November 1, 1927 to January 10, 1928.
Test 2—November 7, 1928 to January 16, 1929.
Test 3—October 12, 1933.
Test 4—March 5, 1930 to May 14, 1930.

Procedure and Conditions: This series of tests deals with the feeding of sweetpotatoes in different combinations. These tests were started in 1927 and continued to 1933. The same type pigs were used in all tests as nearly as possible.

Test 1. Composed of two lots, 12 purebred Poland China pigs to each lot. Average age, 230 days at start of test. Group 1 fed sweetpotatoes, digester tankage and mineral mixture, self-fed, free choice.

Group 2 fed shelled corn, digester tankage and mineral mixture, self-fed, free choice.

The mineral mixture composed of 75 pounds powdered wood charcoal, 6 pounds common salt, 6 pounds marble dust, 3 pounds flowers of sulphur, 6 pounds Glauber's salts, 3 pounds raw rock phosphate and 1 pound powdered copperas.

Pigs were weighed at 14-day intervals throughout the test. Porto Rico potatoes and Whatley Prolific corn were used. The pigs were fed in dry lot.

Test 2.—Composed of two lots, 10 purebred Poland China pigs to each lot. The first group was fed sweetpotatoes with mineral mixture supplement, free choice.

The second group received sweetpotatoes, digester tankage and mineral mixture. Both groups were fed in dry lot.

Mineral mixture same as used in Test 1.

Test 3. Composed of two groups, 9 pigs to each group. The potato lot composed of 6 purebred Poland China and 3 O. I. C. pigs; corn lot composed of 7 Poland China and 2 O. I. C. pigs. The pigs averaged 140 pounds each at the beginning of the test.

The pigs in this test were grazed on one acre of sweetpotatoes and one acre of corn. Yields were estimated at 30 bushels corn per acre and 90 bushels sweetpotatoes per acre. Both groups were allowed access to self-feeder containing digester tankage and mineral mixture. The mineral mixture was composed of equal parts by weight of marble dust, steam bonemeal, hardwood ashes and salt. The pigs in the potato field were hand-fed shelled corn at the rate of about 2 pounds per head daily.

Test 4. This test was composed of two groups of 9 pigs each. Pigs used in this test were Duroc-Jersey and of mixed Duroc-Jersey and Poland China breeding, fairly uniform in type. The average initial weight at start of tests was between 125 and 130 pounds. The pigs were weighed regularly at 14-day intervals, with triple weights at 1-day intervals for the start and close of the experiment.

Pigs were fed under dry lot conditions, first lot receiving sweetpotatoes and protein mineral supplementary mixture, free choice, self-fed, with shelled corn hand-fed once daily, 2 1/3 pounds per head. The second lot received shelled corn and the same protein supplementary mineral mixture, free choice, self-fed. Shelled corn for the first lot was hand-fed late in the afternoon. The protein mineral supplementary mixture contained 60 parts by weight of cottonseed meal, 15 parts fish meal, 7½ parts digester tankage, 7½ parts buttermilk, 7½ parts alfalfa leaf meal, 1 part common salt, 1 part marble dust and 1 part cod-liver oil.

Results:

	Test 1		Test 2		Test 3		Test 4	
	Sweetpotatoes vs. shelled corn		Sweetpotatoes vs. sweetpotatoes and tankage		Sweetpotatoes grazed and corn vs. corn grazed		Sweetpotatoes and corn vs. corn dry lot	
	Sweet-potatoes	Shelled corn	Sweet-potatoes no tankage	Sweet-potatoes and tankage	Sweetpotatoes grazed plus corn	Corn grazed	Sweetpotatoes plus shelled corn	Corn (no potatoes)
Length of test (days)	70	70	70	70	42	30	70	70
Number pigs in test	12	12	10	10	9	9	9	9
Average initial weight (lbs.)	96.9	98.5	105.2	105.4	140.9	139.6	126.6	129.1
Average final weight (lbs.)	145.6	207.1	122.7	156.3	213.5	180.7	220.2	251.1
Average daily gain (lbs.)	0.7	1.55	0.25	0.73	1.73	1.37	1.34	1.74
Average total gain per pig (lbs.)	48.7	108.6	17.5	50.9	72.6	41.1	93.6	121.9
Av. daily feed consumption per pig								
Sweetpotatoes (lbs.)	14.82	—	14.94	14.95	—	—	11.13	—
Sweetpotatoes grazed* (lbs.)	—	—	—	—	14.2	—	—	—
Shelled corn	—	6.27	—	—	1.95	—	2.33	7.15
Corn grazed* (lbs.)	—	—	—	—	—	6.2	—	—
Digester tankage (lbs.)	0.80	0.59	—	0.77	0.99	0.66	—	—
Mineral mixture (lbs.)	0.029	0.009	0.04	0.028	0.05	0.06	—	—
Supplement mixture (lbs.)	—	—	—	—	—	—	1.40	1.03
Feed per 100 lbs. gain (lbs.)								
Sweetpotatoes	2129.3	—	5974.3	2056.0	—	—	831.6	—
Sweetpotatoes grazed*	—	—	—	—	820.7	—	—	—
Shelled corn	—	404.6	—	—	114.6	—	174.0	410.9
Corn grazed*	—	—	—	—	—	452.6	—	—
Digester tankage	115.0	38.8	—	105.9	57.9	48.1	—	—
Minerals	4.19	0.61	17.71	3.92	3.09	4.59	—	—
Supplement mixture	—	—	—	—	—	—	104.5	59.4

*Assuming the estimated yields were correct and that all sweetpotatoes and corn was eaten.

Reference: Georgia Agricultural Experiment Station Bulletin 181, "Sweetpotatoes As a Feed for Swine," pages 5, 6, 8, 9, 10, and 14, tables 1, 2, 3, and 5, Experiment, Georgia, April 1934.

Sweetpotato Feeding Experiment with Hogs

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: Test 1—December 8, 1927 to January 19, 1928.
Test 2—January 25, 1928 to March 12, 1928.
Test 3—December 12, 1928 to January 30, 1939.

Purpose: To determine the value of sweetpotatoes as a feed for swine.

Procedure and Conditions: In 1927 the Louisiana Experiment Station started a series of tests to determine the value of sweetpotatoes as a feed for hogs. Various comparisons and combinations of feeding sweetpotatoes was used in this series of tests.

Test 1 consisted of three lots of 10 hogs per lot. Grade hogs were used in this test. In this test comparisons were made of (1) sweetpotato fed in dry lot with and without tankage, and (2) sweetpotatoes versus corn. Tankage was fed free choice.

Test 2 consisted of two lots of nine hogs each. One hog in each lot died of pneumonia during the test. Feeding was done in dry lot, tankage being fed free choice.

Test 3 consists of two lots of 20 hogs each. Each lot of 20 hogs was placed on a 2-acre plot of Porto Rico sweetpotatoes of an estimated yield of 194 bushels per acre. Lot 1 had sweetpotatoes in the field plus tankage fed in a self-feeder, lot 2 received sweetpotatoes in the field and no tankage.

Results:

	Test 1			Test 2		Test 3	
	Tankage with sweetpotatoes in dry lot			Corn, sweetpotatoes and tankage vs. corn and tankage		Sweetpotatoes grazed with and without tankage	
	Corn, tankage	Sweetpotatoes, tankage	Sweetpotatoes, no tankage	Corn, Sweetpotatoes, tankage	Corn and tankage	Sweetpotatoes in field, tankage	Sweetpotatoes in field, no tankage
Length of test (days)	42	42	42	42	42	35	35
No. pigs in test	10	10	10	9	9	20	20
Av. initial weight	104.3	104.3	104.3	71.7	73.6	93.5	93.5
Av. final weight	168.5	142.7	115.5	98.7	116.3	144.5	123.9
Gain per pig	64.2	38.4	11.2	27.0	42.7	51.0	30.45
Av. daily gain	1.53	.91	.27	.64	1.01	1.46	.87
Av. daily ration							
Corn	5.1	—	—	1.98	3.84	—	—
Sweetpoatoes	—	15.3	15.6	10.98	—	31.04*	31.04*
Tankage	.88	1.58	—	0.5	0.44	.46	—
Feed per 100 lbs. gain							
Corn	333.8	—	—	273.4	335.5	—	—
Sweetpotatoes	—	1671.9	5852.7	1515.2	—	2132.2	3567.8
Tankage	57.9	173.2	—	66.5	38.9	31.9	—
Minerals	1.09	2.34	3.56	—	—	—	—

*Estimated amount of potatoes eaten daily per pig.

Reference: Louisiana Agricultural Experiment Station Bulletin 236, "Hogging Off Corn and Sweetpotatoes," pages 19, 21, and 22, tables 6, 7, and 8, March 1933, Baton Rouge, Louisiana.

Value of Tankage for Swine on Grazing Peanuts

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Purpose: To obtain the direct value of tankage as a supplement for swine on peanut grazing.

Procedure and Conditions: Twenty head of Poland China pigs, averaging about 80 pounds were selected and divided into two uniform groups according to sex, weight, and thriftiness. Two acres of peanuts were fenced, both acres yielding approximately 1,000 pounds of peanuts per acre. Ten pigs were put on each acre. Both lots of pigs received 2 pounds of corn per head daily and a mineral mixture self-fed, free choice. Both lots had free access to water. One lot received tankage self-fed, free choice, and the other received no tankage. The lot receiving tankage did not consume all of the two pounds of corn each day, this being weighed back and subtracted from their allotted amount.

Results:

VALUE OF TANKAGE FOR SWINE ON GRAZING PEANUTS

	Lot 1 no tankage	Lot 2 tankage
Extra feed consumed:		
Corn (lbs.)	966	700
Tankage (lbs.)	—	200
Minerals (lbs.)	6	6
Value of extra feed (dollars)	8.69	9.91
Number of days on test	49.0	43.0
Total weight at start (lbs.)	836.66	784.34
Average weight at start (lbs.)	83.86	78.43
Total weight at end (lbs.)	1296.00	1351.00
Average weight at end (lbs.)	129.60	135.10
Total gain (lbs.)	457.34	566.66
Average gain per pig (lbs.)	45.73	56.66
Average daily gain (lbs.)	0.919	1.317

Reference: Georgia Agricultural Experiment Station Circular 118, "Protein Supplements for Swine," page 7, table 4, Experiment, Georgia, July 1939.

Deficiencies of Peanuts When Used as a Feed for Swine

Conducted by: Florida Agricultural Experiment Station.

Conducted at: Gainesville, Florida.

Period: Tests 1 and 2—132 days.
Test 3—117 days.

Purpose: To determine the value of peanuts as a feed for swine.

Procedure and Conditions: Three separate dry-lot tests with feeder pigs in which No. 1 shelled peanuts formed the basal ration have been completed. In each test the 10 pigs were divided into five groups of two pigs each. Each pig, however, was kept in an individual pen and fed separately. The data reported are the averages for the six pigs of each lot. The initial weight of the pigs in test 1 was 57.8 pounds; test 2, 49.2 pounds; and test 3, 46 pounds.

Results:

DEFICIENCIES OF PEANUTS AS FEED FOR SWINE

Lot	Average daily gain	Peanuts required per pound of gain (pounds)
1 Peanuts	0.43	3.13
2 Peanuts*	0.47	2.87
3 Peanuts, 99 parts; calcium carbonate, 1 part*	1.00	2.03
4 Peanuts, 99 parts; cod-liver oil, 1 part*	0.53	3.09
5 Peanuts, 98 parts; cod-liver oil, 1 part: calcium carbonate, 1 part*	0.81	2.18

*Feed two grams of common salt per pig per day.

Reference: Florida Agricultural Experiment Station 1939 Annual Report, page 75, June 30, 1939, Gainesville, Florida.

Peanuts Grazed Alone Versus Peanuts Grazed Supplemented With Corn and Cottonseed Meal Self-fed in Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: October 20, 1930 to November 17, 1930.

Procedure and Conditions: In the fall of 1930, 16 pigs averaging 47.12 pounds were divided into two lots of eight each. Lot 1 was grazed on peanuts alone while lot 2 was grazed on a comparable area of peanuts and in addition was allowed access to a self-feeder containing a mixture of two parts ground corn and one part cottonseed meal. Lot 2 receiving corn and cottonseed meal made forty pounds more gain than lot 1 on peanuts alone. To produce this extra gain the pigs in lot 2 consumed 258.5 pounds of the mixture of corn and cottonseed meal, the small consumption of grain evidencing the palatability of the peanuts.

Results:

GRAZING PERIOD: OCTOBER 20, 1930 TO NOVEMBER 17, 1930

	Peanuts grazed alone	Peanuts grazed Supplemented with corn and cottonseed meal
Number of pigs used	8	8
Length of grazing period (days)	28.	28.
Average initial weight (lbs.)	47.12	47.12
Average final weight (lbs.)	83.37	88.37
Average gain per pig (lbs.)	36.25	41.25
Average daily gain per pig (lbs.)	1.29	1.47
Grain fed per pig (lbs.)	—	32.5
Average amount of grain fed daily (lbs.)	—	1.16
Grain fed per cwt. of gain (lbs.)	—	78.9

Grazing Trials With Peanuts at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1919-1922.

Procedure and Conditions: Grazing trials with peanuts were conducted in 1919, 1921 and 1922. The stand during each of the latter two years was probably less than 50 percent of the normal which accounts for the small amount of pork producted per acre in these trials. The figures for 1919 are therefore more nearly representative of the results which may be expected in this section of the State with an ordinarily good crop of peanuts. The yield of peanuts that year was estimated at 45 bushels per acre. In 1922 the average daily gain per hog was smaller than either of the other years, owing partially to the scarcity of peanuts in the field during the last week of the trial.

Results:

PEANUTS FOR PORK PRODUCTION

	1919	1921	1922
Date of starting	October 15	September 30	October 6
Area grazed (acres)	2.3	4.75	4.75
Number of hogs used	12.	12.	12.
Length of grazing period (days)	36.0	39.5	38.5
Initial weight, total (lbs.)	1389.0	1161.0	1515.0
Average initial weight (lbs.)	115.75	96.7	126.3
Final weight, total (lbs.)	2196.0	2050.0	2153.0
Average final weight (lbs.)	182.5	170.8	179.4
Total gain (lbs.)	801.0	889.0	638.0
Average gain per hog (lbs.)	66.75	74.08	53.2
Average daily gain per hog (lbs.)	1.85	1.88	1.38
Pork produced per acre (lbs.)	347.8	187.16	134.32

Reference: Mississippi Agricultural Experiment Station Bulletin 218, "Grazing and Feeding Trials with Hogs," pages 6 and 7, tables 3 and 4, State College, Mississippi, June 1923.

Hogging Off Corn, Runner Peanuts, and Sweetpotatoes

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: November 19, 1938 to March 17, 1939.

Purpose: To determine the comparative value of corn, runner peanuts, and sweetpotatoes as a hog feed.

Procedure and Conditions: Pigs were placed on these crops on November 19, 1938, and were removed at the completion of the hogging-off period, March 17, 1939. An attempt was made to place the number of feeder pigs on these various crops so that the pigs would reach approximately 225 pounds in weight at the end of the hogging-off period. It was necessary, during the feeding period, to remove some of the pigs and add others.

The sweetpotatoes produced 299.59 pounds of gain in liveweight per acre. The potatoes started decaying to a small extent in early January. On February 1, it was estimated that 20 percent of the potatoes in the ground at that time were decayed. By March 17 no good potatoes were found. It was estimated that the pigs consumed approximately 70 percent of the potatoes produced.

The runner peanuts produced 401.43 pounds of pork per acre. It was estimated that 15 percent of the peanuts remaining in the ground on February 7 were spoiled. By March 17 practically all the nuts remaining in the ground were either sprouted or decayed. It was estimated that from 10 to 15 percent of the peanuts produced either sprouted or decayed and of course were not consumed by the pigs. This loss was experienced during the latter part of the hogging-off period.

The corn produced 381.86 pounds of liveweight gain per acre. The corn kept well in the field, and just prior to the end of the feeding on March 17, very little decaying or weevil damage was noticed

Results:

HOGGING OFF WINTER FATTENING CROPS 1938-1939

	Corn	Runner peanuts	Sweet-potatoes
Number of acres in field	7.33	7	4.94
Number of pigs	25	24	19
Date on test	Nov. 19	Nov. 19	Nov. 19
Date off test	Mar. 17	Mar. 17	Mar. 17
Total number days on test	118.	118.	118.
	Lbs.	Lbs.	Lbs.
Total yield of crop	16183	12430	44850
Crop yield per acre	39 bu.	1776	9078
Total initial weight	1840	1775	1725
Total final weight	4639	4585	3205
Total gain (pounds pork)	2799	2810	1480
Average daily gain	1.25	1.51	.956
Total pounds protein supplement fed	1110	512	1581
Total minerals fed	28	28	25
Total feed consumed by pigs	17321	12970	46456
Crop hogged-off	16183	12430	44850
Protein supplement	1110	512	1581
Mineral	28	28	25
Total feed consumed per pound of gain:	6.19	4.61	31.39
Crop hogged-off	5.78	4.42	30.30
Protein supplement	.40	.18	1.07
Mineral	.01	.01	.02
Gain per acre	381.86	401.43	299.59

(Gain per acre includes protein supplement and minerals fed)

Reference: Georgia Coastal Plain Experiment Station Nineteenth Annual Report, 1938-1939, pages 71 and 73, table 48, Tifton, Georgia, July 1939.

Molassses in Rations for Pigs

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Purpose: To determine the optimum amount of molasses in rations for pigs.

Procedure and Conditions: Cane or blackstrap molasses was fed to fattening pigs with ground corn in the proportions of 20:80 and 40:60. The pigs were full-fed in dry lot and were given a half-pound of tankage daily a head in the two feeds.

Results:

DIFFERENT AMOUNTS OF MOLASSES IN RATIONS FOR PIGS

	Corn plus 0.5 lbs. of tankage daily	Corn 80 molassss 20 plus 0.5 lbs. of tankage daily	Corn 60 molasses 40 plus 0.5 lbs. of tankage daily
Pigs at start	5	5	5
Initial weight per pig, lbs.	95.5	95.2	99.0
Pigs at close	5	5	5
Final weight per pig, lbs.	202.4	187.9	169.1
Average daily gain, lbs.	1.53	1.32	1.00
Days required to gain 160 lbs.	105	122	160
Daily feed per pig, lbs.:			
Corn, ground	5.08	3.66	2.91
Molasses	—	.92	1.94
Tankage	.50	.49	.49
Total	5.58	5.07	5.34
Feed per 100 lbs. gain, lbs:			
Corn, ground	332.46	276.59	290.93
Molasses	—	69.15	193.38
Tankage	32.65	37.22	49.22
Total	365.11	382.96	533.52
Feed per 100 lbs. gain with molasses reduced to 100% of moisture, lbs.	–	375.04	511.39
Value of molasses with shelled corn as 100 percent	—	73.7%	5.2%

Reference: Ohio Agricultural Experiment Station Bulletin 607, "Substitute for Corn for Growing and Fattening Pigs," page 41, table 25, Wooster, Ohio, September 1939.

Cane Molasses as a Supplement for Swine

Conducted by: Hawaii Experiment Station.

Conducted at: Honolulu, Hawaii.

Period: 1929-1932.

Purpose: To determine the value of cane molasses as a supplement for swine.

Procedure and Conditions: The pigs used in these experiments were raised on the university farm and were of Tamworth, Berkshire and Duroc-Jersey-Berkshire crossbred. In dividing them into lots for experimental purposes not only were weight, sex, condition, and probable outcome considered and balanced as equal as possible, but also ancestry and age, information on which is frequently not available about purchased pigs.

The following rations were used:

Control ration	10 percent cane molasses ration	20 percent cane molasses ration
88 lbs. rolled barley	78 lbs. rolled barley	68 lbs. rolled barley
8 lbs. tankage	10 lbs. cane molasses	20 lbs. cane molasses
2 lbs. linseed oil cake meal	8 lbs. tankage	8 lbs. tankage
1 lb. salt	2 lbs. linseed oil cake meal	2 lbs. linseed oil cake meal
1 lb. steamed bone-meal	1 lb. salt	1 lb. salt
	1 lb. steamed bone-meal	1 lb. steamed bone-meal

Results:

CANE MOLASSES RATION FOR PIGS

	Average gain	Daily concentrate feed consumed per pig	Amount of concentrate feed per lb. of gain	Value of molasses as compared with barley lb. for lb.
	Lbs.	Lbs.	Lbs.	Percent
Experiment II, 6 pigs, initial weight 70 lbs., 70 day test:				
Control (no molasses)	1.43	7.12	4.99	—
Fed 10 percent molasses	1.16	5.82	5.02	99.4
Fed 20 percent molasses	.92	5.20	5.65	88.3
Experiment III, 4 pigs, initial weight 102 lbs., 70 day test:				
Control (no molasses)	1.50	7.02	4.69	—
Fed 10 percent molasses	1.64	6.92	4.23	110.9
Fed 20 percent molasses	—	—	—	—
Experiment IV, 5 pigs, initial weight 49 lbs., 126 day test:				
Control (no molasses)	1.03	4.34	4.33	—
Fed 10 percent molasses	1.12	4.34	3.88	111.6
Fed 20 percent molasses	—	—	—	—
Experiment V, 5 pigs, initial weight 81 lbs., 76 day test:				
Control (no molasses)	1.36	6.17	4.54	—
Fed 10 percent molasses	1.44	6.32	4.40	103.2
Fed 20 percent molasses	1.45	6.29	4.34	104.6

Reference: Hawaii Agricultural Experiment Station Bulletin 69, "Cane Molasses As a Supplement to Fattening Ration for Swine," pages 5, 6, and 9, table 10, Honolulu, Hawaii, November 1933.

Protein Supplements for Fattening Hogs

Proteins are nitrogen-bearing compounds composed of carbon, hydrogen, oxygen, and sometimes sulphur, phosphorus, and iron—a group of nutrients essential to animal life. Proteins contain all the elements that carbohydrates do and in addition, nitrogen. Due to the composition of proteins and oxygen, they are energy foods, and due to the nitrogen content they supply building material. Proteins are important constituents of every living cell in the body and of all the muscles of animals. The protein requirements for maintenance alone is much less than for growth and reproduction.

When proteins are used for building purposes the nitrogen is of primary importance. Proteins supplied in excess of the amount required for building is wasted, because proteins cannot be stored and used later. It is important to determine the amount of protein necessary for building and for energy so as to prevent an under- or over-supply.

There are a number of protein feeds available in Mississippi that may be used in supplementing feeds for hogs. Protein supplements are important in the fattening hog ration, because during this period the hog should be constantly growing and building, and this is one of the main functions of protein. Experimental information should be examined closely before deciding what protein feed, or combination of protein feeds, is best to use in setting up a hog feeding program.

Protein Supplements to Corn in Dry Lot for Fattening Pigs

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1924-1926.

Purpose: To compare single protein-rich feeds of plant and animal origin as supplements to corn; combinations of plant and animal proteins as supplements to corn, and these protein-rich feeds and combinations of these feeds as supplements to corn.

Procedure and Conditions: The pigs used were purebred or crossbred Berkshires, Duroc-Jerseys, Hampshires, and Poland Chinas. All pigs were raised on the college farm and were given the double treatment for hog cholera and the treatment for round worms before being put on test. These pigs averaged between 65 and 70 pounds at the beginning of the trials and were carried on test until they reached an average of 200 pounds.

All pigs were fed in dry lots 28 feet by 100 feet in size. Trees and shed-type hog houses furnished shade and shelter. Plenty of fresh water was supplied from a pipe line.

The rations were figured according to Morrison's feeding standards for fattening pigs, and the proportions were changed after periods of 50 pounds gain. No. 2 yellow corn and high grade protein-rich feeds were used.

Individual weights were taken on three consecutive days at the beginning and at the close of the tests and the average of these three weights was taken as the initial and final weights. Individual weights were also taken at regular intervals of 14 days during the tests.

The pigs in all lots were given free access to the following mineral mixture: 12 parts charcoal, 4 parts ground limestone, and 1 part salt.

Results:

PROTEIN SUPPLEMENTS TO CORN IN DRY LOT

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	Corn and tankage	Corn and fish meal	Corn and soybean meal	Corn and peanut feed	Corn soybean meal and fish meal	Corn peanut feed and fish meal
No. pigs in lot	9.71	10	10	9.93	10	10
No. days on test	83.3	72.3	91	102.3	72.3	72.3
Av. initial wt. (lbs.)	68.07	68.23	67.66	68.95	67.91	67.5
Av. final wt. (lbs)	202.1	203.71	199.05	202.04	203.96	200.97
Gain per pig (lbs.)	133.79	135.50	131.38	129.80	126.05	133.47
Av. daily gain (lbs.)	1.61	1.87	1.46	1.28	1.88	1.84
Av. daily feed (lbs.)						
Corn	5.93	6.04	5.07	4.53	5.80	5.78
Tankage	.62	—	—	—	—	—
Fish meal	—	.93	—	—	.46	.55
Soybean meal	—	—	.86	—	.46	—
Peanut feed	—	--	—	1.31	—	.55
Minerals	.03	.03	.11	.12	.08	.09
Feed per 100 lbs. gain: (lbs.)						
Corn	369.34	322.51	349.58	359.22	308.64	313.73
Tankage	38.3	—	—	—	—	—
Fish meal	—	49.64	—	—	24.18	29.97
Soybean meal	—	—	58.91	—	24.18	—
Peanut feed	—	—	—	102.96	—	29.97
Minerals	1.68	1.65	7.2	9.36	4.02	4.82

Reference: South Carolina Agricultural Experiment Station Bulletin 234, "Protein Supplements to Corn in Dry Lots for Fattening Pigs," pages 3, 4, 7, and 12, table 6, Clemson, South Carolina, October 1926.

Experiments with Tankage and Shrimp Meal Singly and in Combination with Cottonseed Meal as Supplements to Corn for Swine. Effects of Adding Cod-Liver Oil to Rations of Fall Pigs

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 70 days, January 31 to April 11, 1930.

Purpose: To compare shrimp meal with standard digester tankage as protein supplement for swine.

To determine the value of cottonseed meal in replacing half of the tankage or shrimp meal.

To determine the value of adding cod-liver oil to a winter fattening ration for fall pigs.

Procedure and Conditions: Nearly all of the pigs used in this test were purebred Duroc-Jerseys, Poland Chinas, and Hampshires raised in the University herd. Nine grade Duroc-Jerseys were purchased from a local feeder. All these pigs had been wormed and vaccinated for cholera.

Feeds were fed in self-feeders with separate compartments for corn, protein supplements, and minerals. Where two protein supplements were used they were mixed and fed together in the same compartment of the self-feeder.

The cottonseed meal was a 7 percent nitrogen meal, the tankage was standard 60 percent digester tankage, and the cod-liver oil was a standard commercial grade.

Results:

Pigs Per Lot	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	8	8	8	8	8	8
	Corn shrimp meal minerals	Corn tankage minerals	Corn shrimp meal cod-liver oil minerals	Corn tankage cod-liver oil minerals	Corn shrimp meal cottonseed meal minerals	Corn tankage cottonseed meal minerals
Av. initial weight (lbs.)	68.6	69.0	68.9	69.9	69.1	68.8
Av. final weight (lbs.)	168.3	145.4	150.1	131.3	175.0	168.0
Av. total gain (lbs.)	99.7	7.64	81.2	70.4	105.9	99.2
Av. daily gain (lbs.)	1.42	1.09	1.16	1.01	1.51	1.43
Average daily ration (lbs.)						
Corn	4.36	3.97	3.97	3.76	4.09	4.05
Tankage	—	.48	—	.42	—	.40
Shrimp meal	.59	—	.49	—	.42	—
Cottonseed meal	—	—	—	—	.42	.40
Cod-liver oil	—	—	.02	.02	—	—
Feed per 100 lbs. gain (lbs.)						
Corn	306.4	363.5	341.7	374.2	270.7	285.4
Tankage	—	43.5	—	41.7	—	28.0
Shrimp meal	41.15	—	42.24	—	27.6	—
Cottonseed meal	—	—	—	—	27.6	28.0
Cod-liver oil	—	—	2.23	2.19	—	—
Minerals	.12	.22	.16	.22	.15	.19
Total concentrates	347.55	407.00	383.94	415.90	325.90	341.40

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Reference: Louisiana Agricultural Experiment Station Bulletin 228, "Protein Supplements and Pastures for Swine," pages 26 and 27, Baton Rouge, Louisiana, July 1932.

Value of Tankage as a Supplement to Corn for Fattening Pigs

Compiled by: Illinois Agricultural Experiment Station.

This summary includes twelve tests from the Ohio Station, three from Kansas, two each from Nebraska and Michigan, and one each from Indiana, Iowa, Alabama and Mississippi.

VALUE OF TANKAGE AS A SUPPLEMENT TO CORN

	Light pigs in dry lot		Heavy pigs in dry lot		Light pigs on pasture	
	Corn	Corn and tankage	Corn	Corn and tankage	Corn	Corn and tankage
Number of tests	6	6	8	8	9	9
Total pigs	24	29	69	69	77	79
Av. days in test	102	102	84	84	113	110
Av. initial weight	63	62	132	134	52	52
Av. final weight	116	186	223	267	161	199
Av. daily gain	.54	1.16	1.04	1.56	.57	1.34
Av. daily ration						
Corn	3.10	3.80	5.63	6.35	3.96	4.63
Tankage	—	.40	—	.54	—	.27
Feed for 100 lbs. gain						
Corn	581.	350.	537.	410.	409.	345.
Tankage	—	36.	—	34.	—	20.
Corn saved by 100 lbs. tankage	—	642.	—	374.	—	320.

Reference: Illinois Agricultural Experiment Station Circular 395, "Feeding Hogs on Illinois Farms," page 11, table 2, Urbana, Illinois, June 1932.

Corn and Protein Supplement Versus Corn Alone for Fattening the Pig

Conducted by: Mississpipi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 199 days.

Purpose: To compare corn alone, self-fed in dry lot versus corn and tankage self-fed on Bermuda grass pasture for fattening pigs.

Procedure and Conditions:

Animals used: Crossbred Poland China-Duroc-Jersey barrows, all from same litter.

Rations:

Lot 1—Corn
Tankage
Bermuda grass pasture
Lot 2—Corn alone

Results:

	Lot 1	Lot 2
Number of hogs	3	3
Total initial weight (lbs.)	196	206
Average initial weight (lbs.)	65.33	68.66
Total final weight (lbs.)	1126.0	556.0
Average final weight (lbs.)	375.33	185.33
Total gain (lbs.)	930.	350.
Average gain per hog (lbs.)	310.	116.66
Average daily gain (lbs.)	1.55	0.58
Total feed consumed		
Corn (lbs.)	3665.	2424.
Tankage (lbs.)	161.	—
Total feed consumed per 100 lbs. gain		
Corn (lbs.)	394.	692.5
Tankage (lbs.)	17.3	—
Total (lbs.)	411.3	692.5

Reference: Mississippi Agricultural Experiment Station Circular 78, "Fattening The Pig: Corn and Protein Supplement Versus Corn Alone," State College, Mississippi, May 1928.

Wheat Middlings as a Complete Substitute for Corn

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Purpose: To determine the value of wheat middlings as a complete substitute for corn.

Procedure and Conditions: The trials were run in which wheat middlings were used as a complete substitute for corn; in one, standard middlings were fed and in the other, flour middlings were fed. Both experiments were run on dry lot.

Results:

WHEAT MIDDLINGS AS A COMPLETE SUBSTITUTE FOR CORN

	For growing and fattening pigs		For fattening shoats	
	Ground corn tankage	Standard middlings tankage	Ground corn tankage	Flour middlings tankage
Number of comparisons	1	1	1	1
Pigs at start	5	5	5	5
Initial weight per pig, lbs.	68	69	102	111
Pigs at close	5	5	5	5
Final weight per pig, lbs.	180	178	245	250
Average daily gain, lbs.	1.22	1.04	1.57	1.52
Days required to gain 160 lbs.	132	154	102	160
Daily feed per pig, lbs.:				
Corn	4.74	—	5.23	—
Middlings	—	4.36	—	5.16
Tankage	.59	.63	.58	.57
Total	5.33	4.99	5.81	5.73
Feed per 100 lbs. gain, lbs.:				
Corn	387.42	—	329.83	—
Middlings	—	419.71	—	335.16
Tankage	48.34	60.40	36.65	37.24
Total	435.76	480.11	366.48	372.40

Reference: Ohio Agricultural Experiment Station Bulletin 607, "Substitute for Corn for Growing and Fattening Pigs," page 28, table 15, Wooster, Ohio, September 1939.

Skim Milk as a Supplement to Corn

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: 70 days, January 20 to March 31, 1915.

Purpose: To compare various proportions of skim milk as a supplement to corn in dry lot feeding.

Procedure and Conditions: The pigs used in the experiments were a little less than 4 months old at the beginning of the feeding period and averaged 58 pounds in weight at that time. Until then they had received a ration of corn, 14 parts; linseed oil meal, 4 parts; and tankage, 1 part.

Feeds used: The five lots were fed as follows:

Lot 1—Corn, 9; tankage 1
Lot 2—Corn, 1; skim milk 1
Lot 3—Corn, 1; skim milk 3
Lot 4—Corn, 1; skim milk 5
Lot 5—Corn and skim milk, both ad libitum

The feeds designated as having been fed ad libitum were not accessible at all times, but were fed at regular intervals, the pigs being given all they would consume within 2 hours. Of the rations so designated, skim milk was fed three times daily and the corn twice daily. No skim milk was fed at noon on weighing days.

Results:

VARIOUS PROPORTIONS OF CORN AND SKIM MILK

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	Corn 9; tankage 1	Corn 1; skim milk 1	Corn 1; skim milk 3	Corn 1; skim milk 5	Corn and skim milk ad lib
Av. initial weight (lbs.)	56.7	61.7	59.3	54.6	58.4
Av. final weight (lbs.)	125.375	155.0	133.125	149.5	178.5
Total gain (lbs.)	273.0	381.5	337.0	399.5	512.5
Av. daily gain (lbs.)	.83	1.16	1.024	1.213	1.558
Feed consumed:					
Corn (bu.)	19	22	16	15.5	15.5
Supplement (lbs.)	118.1	142. gals.	312. gals.	506. gals.	952. gals.
Total (lbs.)	1181.0	2454.0	3584.0	5223.0	9061.0
Feed per 100 pounds gain:					
Corn (bu.)	5.2	5.7	4.7	3.9	3.0
Supplement (lbs.)	43.3	36. gals.	93. gals.	127. gals.	186. gals.
Total (lbs.)	432.6	643.2	1063.5	1307.4	1768.0

1 pig taken out of each lot March 10. Lot 1, 55 lbs., Lot 2, 70 lbs., Lot 3, 101 lbs., Lot 4, 74.5 lbs., and Lot 5, 90.5 lbs.

Reference: Ohio Agricultural Experiment Station Bulletin 316, "Proportion of Supplements to Corn for Fattening Swine," pages 23 and 24, table 15, September 1917, Wooster, Ohio.

Value of Different Protein Supplements for Hogs

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: Four years.

Purpose: To determine the value of different protein supplements for hogs.

Procedure and Conditions:

Animals: Purebred Poland China and Berkshire pigs were used as far as possible in these tests. However, each year it was necessary to purchase some grade pigs whose breeding record and previous feed treatment were unknown. The same number of purebreds was used in each lot. All pigs were double treated for cholera and treated for worms before the feeding tests were started.

Lots: Each lot of pigs was fed in a dry lot 28 by 100 feet in size. Shade and shelter were furnished by trees and shed-type houses. Water was supplied from pipe line.

Feeds: Number 2 yellow corn was used. Menhaden fish meal was used. It was purchased from several mills and showed considerable variation in analysis.

The soybean oil meal was secured from mills in North Carolina. There was very little variation in the protein or fat content of the meals used during these tests.

The cottonseed meal varied very little in protein or fat content and was secured from a local mill.

The peanut meal was purchased from the Suffolk Oil Mills of Suffolk, Virginia. It was a good quality when judged by odor and taste. The protein content varied from 32.75 to 38.88 percent.

The following rations were used:

Lot 1	Lot 2	Lot 4
Corn	Corn	Corn
Fish meal	Tankage	Tankage
Free choice	Soybean meal	Soybean meal
	Hand-fed	Hand-fed

Lot 5	Lot 8
Corn	Corn
Fish meal	Fish meal
Cottonseed meal 7%	Peanut meal
Hand-fed	Hand-fed

The following mineral mixture was self-fed to all lots:

10 parts ground limestone
10 parts special steamed bonemeal
2 parts salt

Weights: Individual weights were taken on three successive days at the beginning and close of the tests. The average of these weights were taken as the average initial and average final weights. Individual weights were taken every 14 days during the test.

Results:

VALUE OF DIFFERENT PROTEIN SUPPLEMENTS FOR HOGS

	Lot 1	Lot 2	Lot 4	Lot 5	Lot 8
Av. initial weight (lbs.)	60.5	59.95	58.37	64.45	58.58
Av. final weight (lbs.)	202.85*	201.79	202.93	201.12	202.96*
Av. daily gain (lbs.)	1.50	1.59	1.56	1.61	1.57
Feed per 100 lbs. gain (lbs.)					
Corn	348.9	310.1	327.4	318.9	329.0
Fish meal	27.0	24.0	—	36.2	26.0
Soybean meal	—	24.0	21.0	—	—
Peanut meal	—	—	—	—	26.0
Cottonseed meal	—	—	—	26.5	—
Tankage	—	—	21.0	—	—

*Average for hogs on feed at close of test.

Reference: South Carolina Agricultural Experiment Station Bullein 281, "Dry Lot Rations for Fattening Hogs," pages 5, 6, 7, and 9, table 3, Clemson, South Carolina, October 1931.

Peanut Meal Compared with Tankage as a Protein Supplement for Hogs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 104 days, March 1 to June 12, 1918.

Purpose: To compare peanut meal with tankage as a protein supplement for hogs.

Procedure and Conditions:

Animals: The animals used in most of the experiments were purebred Duroc-Jersey or Poland Chinas. In a few cases high grades or crossbreds were used. In each experiment special care was taken to have the lots as uniform as possible in age, thrift, weight, breed, sex, and conformation.

Lots: The experiment was conducted in dry lots containing shelters.

Feeds: The hogs were fed the following rations:

Lot 1	Lot 2	Lot 3	Lot 4
Corn—8	Corn—1	Corn—2	Corn—3
40% tankage—1	Peanut meal—1	Peanut meal—1	Peanut meal—1

All hogs were hand-fed.

No. 2 white corn was used. Peanut meal means the product containing hulls.

Water and a simple mineral mixture composed of equal parts by weight of charcoal, air-slaked lime and salt was accessible to hogs at all times.

Weighing: Individual weights were taken on two consecutive days at the beginning and end of experiments.

Results:

PEANUT MEAL COMPARED WITH TANKAGE AS A PROTEIN SUPPLEMENT

	Lot 1	Lot 2	Lot 3	Lot 4
	Lbs.	Lbs.	Lbs.	Lbs.
Average initial weight	54	54	54	54
Average final weight	173	170	171	177
Average daily gain per hog	1.14	1.11	1.12	1.18
Average daily feed per hog:				
Ground corn	4.24	2.40	3.11	3.59
Peanut meal	—	2.40	1.55	1.19
Tankage	0.53	—	—	—
Feed for 100 lbs. gain.:				
Ground corn	372.5	216.0	277.4	303.75
Peanut meal	—	216.0	138.6	101.25
Tankage	46.5	—	—	—

Reference: Alabama Agricultural Experiment Station Bulletin 224, "Peanut Meal As a Protein Supplement to Corn for Fattening Hogs in Dry Lot," pages 4 and 5, table 1, Auburn, Alabama, August 1924.

Fish Meal Compared with Tankage for Hogs

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 85 days.

Purpose: To compare fish meal with tankage as protein supplement for fattening swine.

Procedure and Conditions:

Animals: Twenty-four pigs were divided in two comparable lots and fed for 85 days from self-feeders.

Feeds: The animals were fed the following rations:

Lot 1	Lot 2
Shelled corn	Shelled corn
50% tankage	"Atco" fish meal
Minerals	Minerals

Weights: The pigs were weighed individually every 2 weeks during the experiment.

Results: COMPARISON OF TANKAGE AND FISH MEAL

	Tankage lot 1	Fish meal lot 2
Average initial weight	109.2 lbs.	106.9 lbs.
Average gain per animal after 57 days feeding	99.1	123.3
Average gain per animal after 85 days feeding	149.6	167.7
Average feed consumption first 57 days		
Corn	386.3	417.0
Mineral	.67	.58
Average feed consumption per animal during entire 85 days		
Corn	591.5	642.5
Supplement	54.1	51.1
Mineral	1.13	1.00

Reference: Georgia Agricultural Experiment Station Circular 84, "Swine Feeding and Quality of Pork," pages 4 and 5, Experiment, Georgia, March, 1929.

Protein Supplement for Fattening Hogs

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Coast Station, Summerville, South Carolina.

Period: 4 years, 1935-1939.

Purpose: To determine the value of Menhaden fish meal, meat and bone scraps, digester tankage and sardine meal as protein supplements.

Procedure and Conditions: Ten purebred Poland China pigs of fall farrow have been used in each lot and the feeding period has been continued until an average weight of 20 pounds was reached.

The ration of white corn and protein supplement was full-fed free choice in all lots. In addition to the concentrates each lot of pigs was allowed to graze at all times on one acre of rye.

Results: PROTEIN SUPPLEMENTS FOR FATTENING HOGS

	Menhaden fiish meal	Meat and bone scrap	Digester tankage	Sardine meal
Days on test	83.75	86.50	91.25	82.00
Pigs per lot	10.00	10.00	10.00	10.00
Average initial weight (lbs.)	62.31	62.73	62.74	62.33
Average final weight (lbs.)	201.97	200.45	200.59	202.41
Average gain per hog (lbs.)	139.66	137.72	137.85	140.08
Average daily gain (lbs.)	1.667	1.591	1.509	1.704
Feed per 100 pounds gain (lbs.)				
Corn	320.20	319.36	317.86	320.84
Supplement	23.57	43.93	33.23	27.34
Total	343.77	363.29	351.09	348.18

Reference: South Carolina Agricultural Experiment Station Fifty-second Annual Report, pages 100 and 101, table 33, Clemson, South Carolina, December 1939.

Feeding Varying Amounts of Cottonseed Meal to Find the Optimum That Can Be Safely Used in Swine Production in Texas

Conducted by: Texas Agricultural Experiment Station.

Conducted at: College Station, Texas.

Period: Two tests, each run 120 days each.

Purpose: To determine the optimum amount of cottonseed meal that can be safely used in swine rations.

Procedure and Conditions: The pigs used in this experiment were purebred Duroc-Jersey pigs, bred by the Texas Agricultural Experiment Station. They were placed on test about 30 days after weaning, or as soon as they recovered from cholera inoculation and worm treatment.

The experiment was conducted in dry lots, and the rations were mixed and fed in self-feeders placed on concrete floors in the feeding barn. Water was available for the pigs at all times. This experiment, being run in dry lots, and using pigs weighing 55 to 65 pounds live weight, is a severe test, for many of the deficiencies of a feed may never come to the attention of the investigator where the pigs weigh from 90 to 110 pounds live weight before being placed on test, or when they are fed on green pasture.

Previous to going on experiment, the pigs in this experiment were fed a mixture of milo 85 parts, wheat gray shorts 15 parts, and tankage 10 parts.

	Rations fed—pounds of feed in rations					
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	Milo chops 90 tankage 10	Milo chops 89 tankage 8, C. S. meal 3	Milo chops 88 tankage 6, C. S. meal 6	Milo chops 87 tankage 4, C. S. meal 9	Milo chops 86 tankage 2, C. S. meal 12	Milo chops 85 C.S. meal 15
No. pigs at beginning	20	20	20	20	20	20
No. of pigs at close	20	20	20	20	20	17
Average initial weight (lbs.)	60.2	60.2	60.2	60.2	60.2	60.2
Average final weight (lbs.)	282.7	283.3	257.3	255.8	239.5	215.3
Average daily gain (lbs.)	1.85	1.85	1.64	1.62	1.46	1.29
Average total gain (lbs.)	222.6	223.1	197.2	195.6	179.3	155.1
Feed required per 100 lbs. gain (lbs.)						
Ground milo	354.	337.	346.	348.	347.	346.
Cottonseed meal	—	11.5	23.7	36.0	48.6	61.0
Tankage	39.0	30.0	23.7	16.0	8.0	—

Reference: Texas Agricultural Experiment Station Bulletin 410, "Cottonseed Meal As a Feed for Hogs," pages 19, 20, 21, and 22, tables 12, 13, 14, 15, 16, and 17, College Station, Texas, March 1930.

Minerals for Fattening Hogs

There are several mineral elements needed for the proper development of animals. Some of the most important elements are: calcium, phosphorus, iron, potassium, and magnesium. Calcium and phosphorus are the most important of these elements in the development of the body tissues and frame work. Most feeds contain some of the essential mineral elements, but often not in sufficient quantities.

The lack of mineral elements for growing and fattening hogs often causes a weak skeleton, which results in breaking down in the back and pasterns. Often times, fattening hogs are cripples which may be caused in many cases by mineral deficiencies. A sufficiency of minerals also lowers feed requirements per unit of gains. It is generally necessary to provide hogs with additional minerals from sources other than plants unless they have access to a large variety of plants.

A Simple Mineral Mixture for Fattening Hogs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: Experiment 1—106 days, January 5 to April 21, 1923.
Experiment 2—74 days, March 10 to May 23, 1923.

Purpose: To determine the value of adding a simple mineral mixture to a ration of corn and peanut meal.

Procedure and Conditions:

Animals used: All the pigs used in these experiments were purebred Poland Chinas, Duroc-Jerseys, or crosses from purebred of these two breeds. Two lots were fed in each experiment. In both cases special care was taken to have the two lots as nearly alike as possible in breed, thrift, weight, sex, conformation, and condition.

Quarters: The quarters used were pens with concrete floors in the experimental hog barn at Auburn. These pens were well lighted and ventilated. In each experiment the two lots were fed in adjoining pens.

Rations: Lot 1—Ground corn—2 parts
Peanut meal—1 part
Mineral mixture
Self-fed

Lot 2—Corn—2 parts
Peanut meal—1 part
Self-fed

The mineral mixture was composed of:
Charcoal—1 pound
Marble dust—1 pound
Salt—1 pound

Water was kept before the hogs at all times.

Feeding: The corn was ground and mixed with the peanut meal. The mixture was fed in self-feeder. A close watch was kept on the feeders to insure a supply of feed being kept before the hogs at all times.

The peanut meal used in both experiments was made from the whole peanut (hulls included) and was guaranteed to contain 36 percent of protein.

Results:

SIMPLE MINERAL MIXTURE FOR FATTENING HOGS

	Experiment 1		Experiment 2	
	Lot 1	Lot 2	Lot 1	Lot 2
Number of hogs to lot	10.	10.*	9.	9.**
Average initial weight (lbs.)	72.9	73.0	56.6	57.6
Average final weight (lbs.)	171.0	118.0	157.1	122.2
Av. daily gain per hog (lbs.)	.93	.46	1.36	.97
Av. total gain per hog (lbs.)	98.1	45.0	100.5	64.6
Average daily feed per hog:				
Ground corn (lbs.)	2.51	1.75	3.36	2.81
Peanut meal (lbs.)	1.25	0.88	1.68	1.41
Mineral mixture (lbs.)	.07	—	0.13	—
Total (lbs.)	3.83	2.63	5.17	4.22
Feed for 100 lbs. gain				
Ground corn (lbs.)	271.5	381.0	247.2	291.5
Peanut meal (lbs.)	135.7	191.0	123.6	145.7
Mineral matter (lbs.)	7.7	—	0.093	—
Total	414.9	572.0	380.4	437.2

*2 hogs died in non-mineral lot.

**2 hogs were removed from non-mineral lot on account of broken legs.

Reference: Alabama Agricultural Experiment Station Bulletin 222, "A Simple Mineral Mixture for Fattening Pigs," pages 5, 6, 7, and 8, tables 1 and 2, Auburn, Alabama, February 1924.

Temporary Pastures for Hogs

The soil and climatic conditions in Mississippi are such that many crops are grown successfully. These crops include cowpeas, velvet beans, soybeans, sorghum, rye, oats, rape, wheat, sudan grass, vetch, Austrian winter peas, and others. Some or all of these crops may be used as temporary grazing for hogs. By proper planning it is possible to have green feed available for hogs practically the year round, which materially reduces the amount of grain necessary to produce 100 pounds of pork.

The average yield of corn in Mississippi is very low, which might make pork production in some sections of the state unprofitable. Where the corn yield is very low the use of soiling crops and temporary grazing may be used as a means of producing pork profitably. The use of soiling crops and temporary grazing should be considered in setting up a production program for hogs in Mississippi.

Cowpeas Grazed

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: Two years, 1917-1918.

Purpose: To determine the value of cowpeas grazed for fattening hogs.

Procedure and Conditions: In the fall of 1917, eight shoats (purebred Duroc-Jerseys) averaging 126.75 pounds were turned on 1.5 acres of cowpeas. The peas had made a rank growth but showed very little fruit. What fruit there was in the field was ripe and a second growth of vines had already started. The pigs were turned into the field August 29 and the cowpeas were completely exhausted September 26.

In the fall of 1918, ten shoats averaging 11.5 pounds were turned on 1.75

acres of cowpeas. The peas showed a luxuriant growth of vines and a good crop of fruit. On August 23 when the pigs were turned into the field about two-thirds of the pods were ripe. The cowpeas were exhausted September 28.

Results:

GRAZING COWPEAS

	1917	1918
Length of trial (days)	28	36
Number of hogs used	8	10
Area grazed (acres)	1.5	1.75
Average initial weight (lbs.)	126.75	111.5
Average final weight (lbs.)	131.5	151.1
Average gain per hog (lbs.)	4.75	39.6
Average daily gain per hog	.17	1.1
Pork produced per acre (lbs.)	25.3	226.3

Reference: Mississippi Agricultural Experiment Station Bulletin 218, "Grazing and Feeding Trials with Hogs," page 5, table 2, State College, Mississippi, June 1923.

Velvet Bean Grazing for Fattening Hogs

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: Two years, 1917-1918.

Purpose: To determine the grazing value of velvet beans for fattening hogs.

Procedure and Conditions: Four lots of six hogs each were used and were handled as follows:

Lot 1 was grazed on velvet beans as grown alone.

Lot 2 was grazed on velvet beans which had been grown with corn, the corn having been gathered before the hogs were turned on to the field.

Lot 3 was grazed on velvet beans which had been grown with corn, the corn having been gathered and the beans being supplemented with corn hand-fed.

Lot 4 was grazed on velvet beans and corn as grown together in the field.

The hogs in lot 1 were purebred Duroc-Jerseys while those in the other lots were good grades of mixed breeding.

In all lots the beans used were the Early Speckled. Those in lot 1 were in rows four feet apart, while in the other lots the corn and beans were in alternate rows three and one-half feet apart, each thinned to two feet apart in the row. The yield of corn in lot 2 was 26.3 bushels and the yields in lots 3 and 4 were estimated to have been the same. The beans in all lots were well fruited, the yields in lots 2, 3, and 4 being estimated each at eight hundred pounds of beans and pod. It was estimated in all instances that about ninety percent of the beans were matured at the beginning of the grazing period. No shelter was provided in any of the lots.

Results:

VELVET BEAN GRAZING FOR FATTENING HOGS

Date of starting	Lot 1 Oct. 31	Lot 2 Oct. 25	Lot 3 Oct. 25	Lot 4 Oct. 25
Area grazed (acres)	1.25	1.	1.	1.
Number of hogs used	6.	6.	6.	6.
Length of grazing period (days)	57.	70.	90.	81.
Average initial weight (lbs.)	125.5	118.7	130.7	121.7
Average final weight (lbs.)	160.5	147.7	224.	196.
Total gain (lbs.)	210.	174.	560.	446.
Average gain per hog (lbs.)	35.	29.	93.3	74.3
Average daily gain per hog (lbs.)	.61	.41	1.04	.92
Corn fed (lbs.)	—	—	2655.1	—
Corn fed per hog (lbs.)	—	—	442.5	—
Average amount of corn fed per hog per day (lbs.)	—	—	4.92	—
Corn consumed per cwt. of gain (lbs.)	—	—	474.1	330.*
Pork produced per acre (lbs.)	168.	174.	560.	446.*

*Based on yield of 26.3 bushels.

Reference: Mississippi Agricultural Experiment Station Bulletin 218, "Grazing and Feeding Trials with Hogs," pages 8 and 9, table 5, State College, Mississippi.

Soybean Pasture for Fattening Hogs

Conducted by: Maryland Agricultural Experiment Station.

Conducted at: College Park, Maryland.

Period: 84 days.

Purpose: To determine the value of soybean pasture for fattening hogs.

Procedure and Conditions: The test was conducted on leased land adjoining the Station farm. Shade was provided by pine brush supported on frame-work, or by trees adjacent to the lots occupied by the pigs.

Animals: Duroc-Jersey pigs raised at the Station were divided into lots of 10 pigs each, with 7 barrows and 3 gilts in each lot. The pigs were thrifty and were similar in breeding, type, age and condition for the different lots.

Feeds: No. 2 yellow shelled corn was fed. The tankage was guaranteed to carry 60 percent of protein and was purchased from the manufacturers, a Baltimore packing firm. Steamed bonemeal, specially prepared for feeding; finely ground raw limestone, ordinary granulated stock salt were self-fed in the form of a mixture made up of these three materials.

The soybean forage used in this experiment was of the Virginia variety drilled solid on productive land. Seeding was done on May 26, and grazing was begun on July 15. At that time the plants had made good growth, averaging perhaps eight to ten inches in height. The forage was made up chiefly of the leafy part of the plant; extensive seed formation was prevented by the moderately heavy grazing to which the forage was subjected. Some seeds were formed, but it is not believed that they constituted any important part of the forage eaten. A generous growth of forage was made, and when the experiment closed very little forage remained on any of the plots.

The lots received the following rations:

Lot 1	Lot 2	Lot 3
Dry lot	Soybean forage	Soybean forage
Self-fed corn	Light ration of corn first 56 days	Self-fed corn
Tankage	.2 lbs. tankage daily per pig	Tankage
Minerals	Minerals	Minerals

Approximately the following areas of forage were provided:
Lot 2—136 square rods, 84 days
Lot 4—85 square rods, 60 days
42½ square rods, 24 days.

The mineral mixture consisted of steamed bonemeal 2 parts; finely ground raw limestone, 2 parts; common stock (barrel) salt, 1 part.

Weighing: Individual weights of all pigs were taken once each two weeks. At the beginning of the experiment only one weight was taken of the individual pigs; the final weights are the averages of weights taken on three successive days. In only one instance did a pig lose weight during any two-week period.

Results: SOYBEAN PASTURE FOR FATTENING HOGS

	Lot 1	Lot 2	Lot 3
	Lbs.	Lbs.	Lbs.
Initial weight	687.0	682.0	684.0
Final weight	1960.17	1654.67	2073.5
Daily gain	1.52	1.16	1.65
Feed consumed per 100 pounds gain			
Shelled corn	321.80	271.86	313.29
Tankage	35.03	17.27	22.12
Minerals	3.60	6.02	2.68
Grazing crops (acres)	0.0	.087	.057

Reference: Maryland Agricultural Experiment Station Bulletin 376, "Soybean Pasture for Fattening Hogs," pages 299, 300, and 301, table 1, College Park, Maryland, June 1935.

Corn and Soybeans for Pork Production

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: Lot 1—1917-1919.
Lot 2—1918-1922.
Lot 3—1919-1921.
Lot 4—1918-1922.
Lot 5—1918-1921.

Purpose: To determine the value of soybeans and corn for pork production.

Procedure and Conditions: The soybean crop for each of the five lots was handled as follows:

Lot 1—Growing and grazing soybeans alone.
Lot 2—Growing soybeans with corn, the corn being gathered and the beans grazed.
Lot 3—Growing soybeans with corn, the corn being gathered and the beans grazed and supplemented with a small amount of corn hand-fed.

Lot 4—Growing soybeans with corn, the corn being gathered and the beans grazed and supplemented with a medium amount of corn hand-fed.

Lot 5—Growing and grazing soybeans and corn together.

The soybeans used in all trials were Mammoth Yellow. When grown together, the corn and beans were usually planted from April 20 to May 1, about one and one-half inches deep in from three to three and one-half foot rows, stalks of corn being left about every twenty-four inches with two or three hills of beans between each hill of corn. The beans were planted at the same time as the corn by driving back over the rows made in planting the corn, setting the planter to put the beans in the ground just enough to insure covering. (Planters with duplex hoppers have come into general use since this experiment was conducted.)

The cultivation was the same as for corn, weeds being kept down and the soil mulched. The soil ranged from a light to a heavy clay loam, the former during an ordinarily favorable year, capable of producing from twenty-five to thirty bushels of corn per acre, the latter under like conditions capable of producing from thirty-five to forty bushels.

The hogs used in this work were either raised on the Station farm or were purchased locally. Those raised by the Station were from purebred boars and sows of lard type. The hogs purchased were not usually of as good quality as those grown on the Station farm, being in good thrift but frequently of mixed breeding.

Results:

CORN AND SOYBEANS FOR PORK PRODUCTION

	Lot 1 1917-1919	Lot 2 1918-1922	Lot 3 1919-1921	Lot 4 1918-1922	Lot 5 1918-1921
Date of starting	October	September	September	October	September
Area grazed (acres)	1.44	1.96	1.94	1.42	2.45
Number of hogs used	7.3	10.	10.3	9.8	22.4
Length of grazing period (days)	39.0	42.4	42.4	45.3	52.3
Average initial weight (lbs.)	116.3	102.5	110.0	109.5	99.2
Average final weight (lbs.)	168.0	148.4	168.7	176.4	170.5
Average gain per hog (lbs.)	51.6	46.0	58.7	66.3	71.2
Average daily gain per hog (lbs.)	1.07	1.07	1.37	1.47	1.65
Corn fed per hog (lbs.)	—	–	62.8	135.48	—
Average amount of corn fed per hog per day (lbs.)	—	—	1.45	3.05	—
Corn fed per cwt. of gain (lbs.)	—	—	108.35	206.42	—
Pork produced per acre	260.91	219.95	313.28	435.32	461.6

Lot 1: In 1917 the soybeans were described as being a good stand and showing abundant fruit, and in 1918 as being a good crop, ripening fairly uniformly. At the beginning of the 1917 trial, the beans were in the hard dough stage, only a very few being ripe and the leaves were starting to turn yellow and shed. In 1918 the hogs were turned on when the beans were just starting to pop out of the pods.

Lot 2: In 1918 soybeans and corn were grown together in rows three and one-half feet apart with beans in every row and corn in every other row. There was a light yield of beans that year due to the dry season and thin land. Normal crops of beans were grown in 1920 and 1921, but in 1922 the yield was extremely light. This latter year the pork produced per acre was not secured as the hogs were moved to a new lot before the one in which they were originally grazed was completely exhausted.

Lot 3: In 1919 the soybeans and corn were grown together, the rows being three feet apart with beans in every row and corn in every other row. The corn which was gathered prior to the beginning of the trial yielded thirty-two bushels per acre. The yield of beans, however, was probably not as good as in 1920 and 1921.

Lot 4: The 1918 trial differed from the other reported under this heading in that the beans were grown alone. They were described as a good crop, ripening fairly uniformly. At the beginning of the grazing period, the beans were just starting to pop out of the pods. The corn and soybeans in 1919 were planted in the same manner as those in the same year where the soybeans were supplemented by a small amount of corn. The yield of corn per acre was 26.8 bushels.

Lot 5: In 1918 and 1919 corn and soybeans were grown together with beans in every row and corn in every other row. In 1918, however, the rows were three and one-half feet apart, while in 1919 they were three feet apart. In the former year the land was thin and the season extremely dry, resulting in a light yield of beans. In 1919 a second and larger lot was handled in this manner, the hogs used being grades purchased locally. The corn in the smaller lot in 1919 was estimated at twenty-five bushels per acre.

Reference: Mississippi Agricultural Experiment Station Circular 49, "Corn and Soybean for Pork Production," pages 1, 2, 3, 4, and 5, tables 1, 2, 3, 4, and 5, State College, Mississippi, April 1923.

Value of Spring Sown Rape, Sorghum, and Spanish Peanuts for Hogs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: Rape—May 27 to June 23, 1899.
Sorghum—June 24 to September 2, 1899.
Spanish peanuts—September 1 to November 4, 1899.

Purpose: To compare the value of spring sown rape, sorghum, and Spanish peanuts for hogs.

Procedure and Conditions: The rape pasture was grown on sandy bottom land of medium grade.

The rape which had been grazed made a second growth which was ready for pasturing within a month after the removal of the shoats, but was ruined by the Harlequin cabbage bug before it could be utilized.

The sorghum was grazed at the stages of growth between early bloom and complete maturity and most of it was about five feet high. The yield was rather light, the land being poor, sandy upland, moderately fertilized. The sorghum was drilled and cultivated.

There was only about a two-third stand of peanuts.

Results:

VALUE OF SPRING SOWN RAPE, SORGHUM, AND SPANISH PEANUTS

	Test 1	Test 2	Test 3
	Rape pasture	Sorghum	Spanish peanuts
Feeding period (days)	29	71	28
Feed consumed			
Grazing crop (acres)	.10	.545	.243
Supplement			
Corn meal	317.6	—	333.0
Corn meal and cowpea meal	—	812.0	—
No. pigs on test	7	7.	7.
Total gain (lbs.)	103.0	224.0	121.0
Total gain per acre (lbs.)	1030.0	411.0	498.0
Gain per day per pig (lbs.)	.526	.450	.617
Acres per pig for period grazed	.014	.078	.035

Reference: Alabama Agricultural Experiment Station Bulletin 122, "Grazing and Feeding Experiments with Pigs," pages 11, 14, and 15, Auburn, Alabama, January 1903.

Oats with Vetch or Austrian Peas as Grazing Crops for Fattening Hogs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1926-1929 inclusive.

Purpose: To determine the value of oats with vetch or Austrian winter peas as a supplement to corn and tankage for fattening hogs.

Procedure and Conditions: Each of these four feeding trials included (1) one group of pigs in pasture receiving a ration of corn and tankage, self-fed, free choice; (2) another group on pasture received a ration of corn and tankage limited to 5 percent of the liveweight, and (3) a third group in a dry lot given corn and tankage self-fed, free choice. The pasture lots consisted of 1 acre. Grazing crops used were oats and vetch in 1926-27 and oats and Austrian winter peas in 1928-29. The dry lot was 20 x 60 feet.

The pigs were placed on pasture as soon as sufficient growth was available, dry lot was started at the same time as the grazing groups.

Pigs varying in weight were used in each of the experiments, animals used were purebred Poland Chinas, purebred Duroc-Jerseys, and Poland China-Berkshire cross. Average age of pigs varied each year according to the time pigs could be placed on the pasture crop. All pigs were kept under similar condition prior to being placed on experiment. In each trial the animals were divided into three lots as nearly uniform as possible with reference to breed, sex, weight, conformation and condition.

A mineral mixture composed of equal parts bv weight of charcoal, bonemeal, and salt was supplied to all lots in self-feeders.

Results:

OATS WITH VETCH OR AUSTRIAN PEAS AS GRAZING CROP FOR HOGS

	Lot 1	Lot 2	Lot 3
Rations	Corn tankage minerals self-fed free choice pasture	Corn 12 tankage 1 hand-fed 3% of liveweight minerals self-fed, pasture	Corn tankage minerals self-fed free choice in dry lot
Total number of animals	29	37	37
Av. initial weight per animal (lbs.)	73.15	72.95	73.19
Av. initial value per animal (dol.)	6.02	5.95	6.06
Av. final weight per animal (lbs.)	195.90	164.45	177.55
Av. daily gain per animal (lbs.)	1.76	1.33	1.50
Concentrates required per 100 lbs. gain			
Corn (lbs.)	341.24	274.01	392.12
Tankage (lbs.)	19.83	24.66	27.70
Total (lbs.)	361.07	298.67	419.82

Reference: Alabama Agricultural Experiment Station Bulletin 233, "Oats and Vetch or Austrian Peas as Grazing Crops for Fattening Hogs," pages 4, 5, and 12, table 5, Auburn, Alabama, July 1930.

A Comparison of Winter Forage Crops for Fattening Hogs As to Rate and Economy of Gains

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: The Coast Experiment Station, Summerville, South Carolina.

Period: 1931-32 to 1934-35.

Purpose: To compare rye, oats, barley, and rape as green grazing crops for fattening hogs.

Procedure and Conditions:

Animals used: The hogs used in these tests were fall pigs which weighed 50 to 90 pounds, on the average, at the beginning of the tests, and which had been previously treated for cholera and worms. They were put on forage about the middle of December and were carried to an average final weight of approximately 200 pounds.

Most of the hogs used at the Coast Station were purebred Poland China.

Quarters: Small dry lots with some shade were used for the check lots. The forage lots were one acre in size and were without shade or shelter other than that furnished by houses about 8 x 10 feet in size.

Rations: The following rations were fed.

Lot 1—Shelled white corn and fish meal free choice in dry lot.

Lot 2—Shelled white corn and fish meal free choice in green barley.

Lot 3—Shelled white corn and fish meal free choice on green oats.

Lot 4—Shelled white corn and fish meal free choice on green rape.

Lot 5—Shelled white corn and fish meal free choice on green rye.

Lot 6—Shelled white corn and a mixture of one-half fish meal and

Shelled native-grown white corn was used.

A mineral mixture of five pounds oystershell lime, five pounds bonemeal, and one pound of salt was self-fed all lots

Water was furnished all lots from a pipe line.

The varieties of forage crops used and the method and rate of seeding were as follows:

Forage	Variety Used	Rate of Seeding	Method
Barley	Tennessee Beardless	2 bushels	Broadcast
Rye	Abruzzi	1.5 bushels	Broadcast
Oats	Fulghum	2.5 bushels	Broadcast
Rape	Dwarf Essex	20 pounds	30-inch rows

Results:

COMPARISON OF WINTER FORAGE FOR FATTENING HOGS

Lot number	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Forage	None	Barley	Oats	Rape	Rye	Rye
Number of tests	5	5	4	5	4	3
Days on test	85.4	77.2	77.25	77.20	77.75	81.33
Pigs per lot	9.34	10.0	10.00	10.00	10.00	10.00
Total initial weight (lbs.)	661.80	657.80	682.50	659.00	677.50	609.00
Average initial weight (lbs.)	70.18	65.78	68.25	65.90	67.75	60.90
Total final weight (lbs.)	1915.00	2014.40	2027.50	2016.60	2018.50	2013.00
Average final weight (lbs.)	203.07	201.44	202.75	201.66	201.85	201.30
Total gain (lbs.)	1253.20	1356.60	1345.00	1357.60	1341.00	1404.00
Gain per pig (lbs.)	132.89	135.66	134.50	135.76	134.10	140.40
Average daily gain (lbs.)	1.56 .06	1.76 .03	1.74 .03	1.76 .03	1.72 .03	1.73 .03
Total feed consumed: (lbs.)						
Corn	4170.8	4284.00	4372.20	4293.20	4293.00	4398.67
Supplement	399.2	335.20	327.50	317.80	340.74	566.66
Total	4570.00	4700.20	4611.50	4690.00	4633.75	4965.33
Mineral	24.4	8.2	5.75	7.6	11.00	12.66
Forage, acres	—	.5	.5	.5	.5	.5
Feed per pig per day (lbs.)						
Corn	5.18	5.65	5.55	5.66	5.52	5.41
Supplement	.50	.43	.42	.41	.44	.70
Total	5.68	6.08	5.97	6.07	5.96	6.11
Mineral	.03	.01	007	.01	.014	.016
Forage	—	.00065	.00065	.00065	.00064	.00061
Feed per 100 lbs. gain (lbs.)						
Corn	332.81	321.76	318.51	322.05	320.13	312.30
Supplement	31.85	24.71	24.35	23.41	25.41	40.36
Total	364.66	346.47	342.86	345.46	345.54	353.66
Mineral	1.95	.60	.43	.56	.82	.90
Forage, acres	—	.037	.037	.037	.037	.036

Reference: South Carolina Agricultural Experiment Station Circular 54, "Winter Forages for Fattening Hogs," pages 3, 4, and 8, table 4, Clemson, South Carolina, June 1936.

Soybeans, Cottonseed Meal, and Winter Pasture for Fattening Hogs

Conducted by: Mississippi Agricultural Experiment Station.
Conducted at: State College, Mississippi.
Period: Winter of 1932-33.

Purpose: To compare rations of corn and home-grown proteins to a ration of corn and a bought protein, both in the dry lot and while on pasture. Tests were made to determine the quality of carcasses produced by these feeds.

Results:

SOYBEANS, COTTONSEED MEAL, and WINTER PASTURE FOR FATTENING HOGS

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	Self-fed corn 85% soybeans 15% in dry lot	Self-fed corn 85% soybeans 10% C.S. meal 5% in dry lot	Corn 92% tankage grazing 8% in dry lot	Same as Lot 1 on wheat as winter grazing	Same as Lot 2 on wheat as winter grazing	Same as Lot 3 on wheat as winter grazing
Length of test (days)	67	57	50	53	48	46
Number of pigs	8	8	7	8	8	8
Average initial weight (lbs.)	95.17	100.00	101.77	95.37	97.42	96.80
Average final weight (lbs.)	204.66	198.65	197.81	190.62	188.66	187.37
Average gain (lbs.)	109.49	98.54	96.04	95.25	91.24	90.57
Average daily gain (lbs.)	1.63	1.73	1.92	1.80	1.90	1.97
Feed per 100 lbs. gain:						
Corn (bu.)	5.57	5.54	5.87	5.10	5.39	5.86
Mam. yel. soybeans (lbs.)	55.06	36.52	—	50.43	35.55	—
C. S. meal (lbs.)	—	18.26	—	—	17.78	—
Tankage (lbs.)	—	—	28.61	—	—	28.45
Mineral* (lbs.)	4.11	4.95	2.75	2.43	2.33	1.45

*Mineral mixture of 10 parts ground limestone, 10 parts bonemeal, and 2 parts salt in all lots.

Reference: Paper given by Animal Husbandry Department, Mississippi Experiment Station, Livestock Field Day, May 15, 1934.

Sudan Grass and Rape Pasture Compared to Dry Lot and to Soybean Pasture

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: Lots 1 and 2: May 31 to August 3, 1931.
Lot 3: August 5 to September 26, 1931.

Purpose: To compare Sudan grass and rape pasture with dry lot and soybean pasture.

Procedure and Conditions: The hogs used were principally purebred pigs with some crossbreds and grades, all belonging to the University.

All pigs had shade, plenty of water, and were fed protein supplements, free choice in self-feeders. A mineral mixture of salt, bonemeal, and ground oystershell was also available.

Results:

SUDAN GRASS, RAPE, AND SOYBEAN PASTURE FOR HOGS

	Lot 1 Dry lot	Lot 2 Sudan and rape pasture	Lot 3* Soybeans
Days on test	66	66	42
Pigs in lot	10	30	15
Average initial weight (lbs.)	45.15	44.4	57.6
Average final weight (lbs.)	97.7	101.7	102.9
Average gain (lbs.)	52.5	57.3	45.2
Average daily gain (lbs.)	.79	.87	1.07
Average feed eaten (lbs.)			
Corn	78.00	64.8	51.2
Rice polish	119.75	99.5	27.9
Wheat shorts	32.25	24.2	—
Tankage	11.62	8.2	—
Shrimp meal	—		8.8
Cottonseed meal	11.62	8.2	8.8
Feed per 100 lbs. gain (lbs.)			
Corn	148.6	113.1	114.8
Rice polish	227.7	173.7	61.6
Wheat shorts	61.4	42.2	—
Tankage	22.1	14.3	—
Cottonseed meal	22.1	14.3	19.4
Shrimp meal	—	—	19.4

*Lot 3 is not strictly comparable to the other lots, as this test was made at a later date, and some changes had to be made in the ration. It is presented here in similar form for purposes of comparison. The pigs used were of similar weight, type, and previous treatment.

Reference: Louisiana Agricultural Experiment Station Bulletin 228, "Protein Supplements and Pastures for Swine," pages 33 and 34, Baton Rouge, Louisiana, July 1932.

Permanent Pastures for Hogs

Fattening hogs in dry lot is practiced by many farmers in Mississippi; which is due in many cases to not having permanent pasture fenced for hogs, and the opinion of some that fattening hogs will do better in dry lot than on pasture.

There is considerable experimental information on the value of permanent pasture for fattening hogs. This information should be considered thoroughly before making a decision on this factor in hog feeding.

Value of Permanent Pasture for Hogs

Conducted by: Georgia State College of Agriculture.

Conducted at: Athens, Georgia.

Period: 53 days test, 1928-1929.

Purpose: To determine the value of permanent pasture for feeding hogs.

Results:

VALUE OF PERMANENT PASTURE FOR HOGS

	Shelled corn 60% tankage minerals (dry lot)	Shelled corn 60% tankage minerals (pasture)	Shelled corn 75% cottonseed meal 15% tankage 5% alfalfa 5% minerals (dry lot)	Shelled corn 75% cottonseed meal 15% tankage 5% alfalfa 5% minerals (pasture)
Average gain per pig (lbs.)	75.6	91.26	58.8	77.6
Average daily gain (lbs.)	1.44	1.72	1.11	1.46
Concentrates required per 100 lbs. gain	388.	333.	442.	335.

Unpublished Data, Georgia State College of Agriculture, Athens, Georgia.

Reference: Bulletin of the University of Georgia, Volume XXI, Number 2, "Setting Up a Feeding Program for Hogs," page 52, table 58, March 1939.

The Value of Permanent Pasture for Fattening Pigs

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Raleigh, North Carolina.

Period: 1928-1931.

Purpose: To determine if pigs grazed on a permanent pasture would consume less concentrates or make more rapid gains than those in a dry lot when both groups were full-fed the same grain mixture.

To determine if a permanent pasture would replace fifty percent of the nitrogenous feeds in the grain mixture when pigs were full-fed this mixture and allowed ample grazing in addition.

Procedure and Conditions: The two groups receiving pasture were each confined in an area that contained only one-half acre. The two pastures joined each other, were on comparable soil, and had the same general slope and elevation. Each autumn, when the pigs were removed, any bare spots were reseeded and the following spring nitrate of soda was applied at the rate of 100 pounds per acre.

An abundance of grass was available for lots 2 and 3 in 1928 and 1929 but dry seasons in 1930 and 1931 caused a scarcity of grass and it was necessary to give lot 2 an additional two-tenths of an acre of pasture on September 11, 1931. The pigs in this lot seemed to graze the grass closer than those in lot 3 and did not get sufficient grazing in the latter part of 1930.

Purebred Poland China and Duroc-Jersey pigs, together with a few crossbred pigs from two breeds, were fed in 1929, 1930, and 1931 trials, but during 1928 several Berkshire and Tamworth pigs were used in addition to pigs from the above breeds. All pigs were weaned at 8 weeks of age and were started on experiment as soon thereafter as they could be vaccinated and treated for worms.

Each group of pigs was hand-fed twice daily. The feed mixture for each group was fed dry but ample drinking water was adjacent to the feed troughs at all times. Special double feeding troughs with divisions on each side were used for all three groups, so that each individual pig had a good opportunity to get his share of the feed.

Rations: The composition of the ration was changed for each group as the pigs increased in weight. The changes were made according to the following schedule.

		Group 1	Group 2	Group 3
Kind of pasture		None	Orchard grass	Orchard grass
Feed mixture when pigs averaged 40 lbs. to 60 lbs.	Corn meal	125 lbs.	125 lbs.	125.0 lbs.
	Wheat shorts	50 lbs.	50 lbs.	25.0 lbs.
	Fish meal	25 lbs.	25 lbs.	12.5 lbs.
	Mineral	4 lbs.	4 lbs.	3.3 lbs.
	Total	204 lbs	204 lbs.	165.8 lbs.
60 lbs. to 100 lbs.	Corn meal	200 lbs.	200 lbs.	200.0 lbs.
	Wheat shorts	25 lbs.	25 lbs.	12.5 lbs.
	Fish meal	25 lbs.	25 lbs.	12.5 lbs.
	Mineral	5 lbs.	5 lbs.	4.5 lbs.
	Total	255 lbs.	255 lbs.	229.5 lbs.
100 lbs. to 150 lbs.	Corn meal	250 lbs.	250 lbs.	250.0 lbs.
	Wheat shorts	25 lbs.	25 lbs.	12.5 lbs.
	Fish meal	25 lbs.	25 lbs.	12.5 lbs.
	Mineral	6 lbs.	6 lbs.	5.5 lbs.
	Total	306 lbs.	306 lbs.	280.5 lbs.
150 lbs. to 200 lbs.	Corn meal	325 lbs.	325 lbs.	325.0 lbs.
	Fish meal	25 lbs.	25 lbs.	12.5 lbs.
	Mineral	7 lbs.	7 lbs.	6.8 lbs.
	Total	357 lbs.	357 lbs.	344.3 lbs.

The following grades of feeds were used: No. 3 white corn meal, gray wheat shorts containing 15 percent protein, Menhaden fish meal containing 55 percent protein, aud a mineral mixture consisting of 10 pounds each of finely ground limestone and superphosphate, and 2 pounds of common salt.

Results:

THE VALUE OF PERMANENT PASTURE FOR FATTENING HOGS

	Lot 1	Lot 2	Lot 3
Number pigs used	62.	65.	64.
Number days on feed	100.65	94.92	101.92
Average initial weight (lbs.)	47.23	47.37	47.38
Average final weight (lbs.)	202.00	200.95	201.94
Average gain (lbs.)	154.77	153.58	154.56
Average daily gain per pig (lbs.)	1.54	1.62	1.52
Average daily feed per pig (lbs.)	5.35	5.54	5.54
Feed consumed per pig: (lbs.)			
Corn meal (lbs.)	445.80	435.46	505.87
Wheat shorts (lbs.)	36.59	35.73	21.41
Fish meal (lbs.)	45.32	44.15	25.90
Mineral (lbs.)	10.55	10.31	11.08
Total concentrates (lbs.)	538.26	525.65	564.26
Pasture (acres)	None	.0308	.0344
Feed per cwt. gain:			
Corn meal (lbs.)	288.03	283.52	327.29
Wheat shorts (lbs.)	23.64	23.26	13.85
Fish meal (lbs.)	29.28	28.75	16.76
Mineral (lbs.)	6.82	6.71	7.17
Total concentrates (lbs.)	347.77	342.25	365.07
Pasture (acres)	None	.0200	.0222

Reference: North Carolina Agricultural Experiment Station Bulletin 286, "The Value of Permanent Pasture for Fattening Pigs," pages 3, 4, 5, and 11, table 5, Raleigh, North Carolina, June 1933.

Pasture Crops for Swine

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 100 days, March 2, 1932 to June 10, 1932.

Purpose: To determine the value of various pasture crops for swine.

Procedure and Conditions: Most of the pigs used were loaned by the University and 18 grade Duroc-Jerseys purchased to complete the number required. These were divided into four lots of ten each, two lots being on pasture and two in dry lots. They were fed on ear corn, hand-fed, twice daily and self-fed a protein supplement mixture of 60 parts shrimp meal and 40 parts cottonseed meal. On April 20, this was changed to 60 parts of shrimp meal, 20 parts cottonseed meal, and 20 parts ground alfalfa hay.

One pig became sick on lot 1 (sweet clover) and was removed on the first weighing day (28 days). It later died, and was found to have the lungs adhering to the sides of the chest cavity. One pig on lot 3 (separated milk) proved to be unthrifty and was removed from the experiment on the 56th day.

In the fall of 1931, an area of one and one-half acres of upland adjacent to the experimental feeding pens was set aside for pasture experiments. One acre was seeded to white Dutch clover, to be divided later into two half-acre plots, and one-half acre was seeded to yellow sweet clover, "Melilotus Indica." This land was limed with waste lime from the sugar factory. A good stand of clover was obtained on each plot, but the sweet clover was at its best in March. The white clover was very short on March 2, and was cut down by a late frost on March 10. There was very little white clover pasture for the first month.

Results:

	Lot 1	Lot 2	Lot 3	Lot 4
Ration	Ear corn shrimp meal C.S. meal green alfalfa sweet clover pasture	Ear corn shrimp meal C.S. meal green alfalfa white clover pasture	Ear corn shrimp meal C.S. meal green alfalfa sep. milk dry lot	Ear corn shrimp meal C.S. meal green alfalfa dry lot
Number pigs in lot	9	10	9	10
Av. initial weight (lbs.)	62.4	64.1	65.0	64.8
Av. final weight (lbs.)	186.3	195.3	199.6	183.4
Av. gain per head (lbs.)	123.9	131.2	134.6	118.6
Av. gain per day (lbs.)	1.24	1.31	1.346	1.18
Av. daily feed (lbs.)				
Ear corn	6.0	5.9	6.0	5.95
Estimated shelled corn 69%	(4.14)	(4.07)	(4.14)	(4.10)
Shrimp meal	.49	.38	.26	.50
Cottonseed meal	.27	.22	.17	.30
Ground alfalfa	.056	.036	.025	.036
Separated milk	.—	.—	7.4	.
Feed per 100 lbs. gain (lbs.)				
Corn, shelled (est.)	333.8	310.8	309.6	346.3
Shrimp meal	39.5	29.0	19.7	42.2
Cottonseed meal	21.8	16.0	12.5	25.1
Ground alfalfa	4.5	2.8	1.9	3.1
Separated milk	—	—	551.6	—

Reference: Louisiana Agricultural Experiment Station Bulletin 228, "Protein Supplements and Pastures for Swine," pages 38 and 39, Baton Rouge, Louisiana, July 1923.

Feeding Spring Pigs for Market

Conducted by: Purdue University Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1920-1925.

Purpose: To compare full feeding of spring pigs for early fall market with limited feeding for late fall or winter market on different kinds of pasture.

Procedure and Conditions: March and April pigs sired by Duroc-Jersey boars and out of Poland China sows were used in the various trials. There were 20 pigs in each trial, 10 with full feed, and 10 with limited feed of grain. The most of these pigs were raised on the Experiment Swine Farm. During the suckling period they were self-fed a mixed ration of 80 pounds corn, 20 pounds wheat shorts and 10 pounds tankage, and had access to blue grass and timothy pasture. From weaning time until the pigs were started in the experiment, shelled corn, wheat shorts, tankage, and a mineral mixture composed of 10 pounds wood ashes, 10 pounds 16 percent superphoshate and 1 pound common salt, were fed free choice in self-feeders. In most cases good clover or alfalfa pasture was used during this period. All of the pigs were weaned at eight weeks of age and were in good thrifty condition when put into the experimental lots.

Rations:

Full Feed: Shelled corn and 60 percent tankage self-fed, free choice, on pasture.

Limited Grain: Shelled corn 95 parts and tankage 5 parts by weight mixed and hand-fed twice daily in limited quantity while on pasture, and shelled corn and tankage self-fed free choice during the finishing period in dry lot.

Results:

FEEDING SPRING PIGS FOR MARKET

Trial number	1	2	3	4	5	6	7	8	9	Average
Date begun	July 4, 1920		July 2, 1921		June 28, 1922		June 27, 1923	June 26, 1924	June 25, 1925	June 30
Kind of pasture	Clover	Rape	Clover	Alfalfa	Clover	Alfalfa	Alfalfa	Alfalfa	Clover	
Av. initial weight (lbs.)	74	74	62	62	68	63	76	74	63	69
Av. final weight (lbs.)	219	219	220	220	208	208	221	220	219	217
Av. daily gain										
Full feed (lbs.)	1.80	1.74	1.82	1.90	1.53	1.62	1.77	1.66	1.88	1.64
Limited grain* (lbs.)	1.27	1.21	1.27	1.29	1.12	1.15	1.19	1.17	1.20	1.21
Date finished for market										
Full feed (lbs.)	Sept. 22	Sept. 25	Sept. 27	Sept. 24	Sept. 28	Sept. 22	Sept. 17	Sept. 22	Sept. 16	Sept. 23
Limited grain (lbs.)	Oct. 27	Nov. 2	Nov. 3	Nov. 2	Oct. 31	Oct. 28	Oct. 30	Nov. 1	Nov. 2	Oct. 31
Feed required 100 lbs. gain										
Full feed (lbs.)										
Corn	322.6	334.6	336.0	327.6	336.1	335.0	324.6	334.0	316.7	329.6
Tankage	21.2	23.8	29.8	24.8	30.6	26.6	20.5	25.5	23.4	25.1
Limited gain* (lbs.)										
Corn	314.4	313.6	320.8	317.4	325.0	314.0	366.3	332.5	326.4	325.9
Tankage	13.3	17.3	17.5	17.3	18.4	19.8	16.8	14.7	12.8	16.4
Pasture required for 10 hogs										
Full feed (acres)	.5	1.0**	.5	.5	.5	.5	.5	.5	.5	.5
Limited feed (acres)	1.5	3.0**	1.5	1.0	1.5	1.5	1.5	1.5	1.5	1.44
Gain and Feed Requirements of the Pigs Fed by Limited Grain Method										
Av. daily gain growing on pasture (lbs.)	.77	.68	.68	.73	.72	.71	.74	.67	.76	.72
Weight at close of pasture season (lbs.)	136.0	128.0	120.0	124.0	133.0	132.0	141.0	138.0	131.0	131.0
Av. daily gain fattening in dry lot (lbs.)	2.39	2.22	2.63	2.60	2.18	2.41	2.21	2.56	2.21	2.38
Feed consumed per 100 lbs. gain										
Growing period (lbs.)										
Corn	248.4	270.3	239.9	222.6	270.5	262.9	278.4	299.2	243.4	259.5
Tankage	13.8	15.5	13.6	13.2	16.2	17.2	14.7	15.8	12.8	14.8
Fattening period (lbs.)										
Corn	363.2	338.7	368.6	379.5	372.4	356.5	432.3	355.8	390.1	373.0
Tankage	13.0	18.4	19.7	20.0	20.3	22.1	18.5	14.0	12.7	17.6

*Based on entire feeding period

**In 1920 the rape was rated as one-half a normal crop. This crop is not included in the average.

Reference: Purdue University Agricultural Experiment Station Bulletin 279 (revised), "Feeding Spring Pigs for Market," pages 4, 5, 7, and 10, tables 1, 2, and 4, Lafayette, Indiana, July 1928.

Tankage for Fattening Spring Pigs on Legume Pasture

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: Six years, 1920-1925.

Purpose: To determine the value of tankage when fed with corn and legume pasture to spring pigs.

Procedure and Conditions: Twenty pigs were in each trial, 10 with shelled corn and pasture and 10 with shelled corn, tankage and pasture.

Both groups were fed to the same market weight.

Rations were self-fed free choice.

Half-acre units of pasture were used for the experimental lots. Each group of ten pigs was started with one-half acre of pasture. The pigs were removed to a new half acre in case of shortage of pasture. They were returned to the original lot when the pasture had made sufficient growth to meet their needs.

Yellow corn was used in all of the feeding trials. Tankage containing 60 percent protein was used in all trials. The alfalfa pasture was of good quality and one-half acre furnished a surplus of pasture for the pigs receiving tankage and adequate pasture for those without tankage. The clover pasture varied from year to year due to weather influences. In 1920 and 1921 the clover continued growing and furnished plenty of pasture throughout the grazing period but did not seem to have the good grazing qualities of the clover grown in the drier years. In 1922 and 1925 the clover became very dry. In 1922 the pigs were practically without pasture for a ten day period in August.

Automatic water fountains supplied fresh water to the pigs in all trials. Salt was supplied to the pigs in all lots. In the earlier trials flake salt was used, and in the latter pressed block salt.

Results:

TANKAGE FOR FATTENING SPRING PIGS ON LEGUME PASTURE

	1 1920	2* 1921	3 1922	4 1923	5 1924	6 1925	Av. 1920-25
Kind of pasture	Clover	Clover	Clover	Alfalfa	Alfalfa	Clover	
Date began	July 4	July 2	June 28	June 27	June 26	June 25	
Average initial weight (lbs.)	74	62	68	76	74	63	71
Average final weight (lbs.)	219	220	208	221	220	219	217
Average daily gain							
With tankage (lbs.)	1.80	1.82	1.53	1.77	1.66	1.88	1.72
Without tankage	1.31	.98	1.28	1.46	1.34	1.50	1.38
Date finished for market							
With tankage	Sept. 22	Sept. 27	Sept. 28	Sept. 17	Sept. 22	Sept. 16	Sept. 21
Without tankage	Oct. 23	Dec. 10	Oct. 15	Oct. 5	Oct. 13	Oct. 7	Oct. 13
Extra time required by pigs without tankage (days)	31	74	17	18	21	21	22
Feed requirements							
With tankage							
Shelled corn (lbs.)	322.6	336.0	336.1	324.6	334.0	316.7	326.6
Tankage (lbs.)	21.2	29.8	30.6	20.5	25.5	23.4	24.2
Without tankage							
Shelled corn (lbs.)	381.6	489.8	378.2	371.1	390.8	356.9	375.5
Pasture required for 10 pigs							
With tankage (acres)	.5	.5	.5	.5[1]	.5[1]	.5	.5
Without tankage (acres)	1.0	1.0	1.0	.5	.5	.75	.75

[1] Although ½ acre lots were used there was a surplus of alfalfa pasture.

*Trial 2 is not included in the average figure as the group of pigs without tankage in this trial represents a very extreme case.

Reference: Indiana Agricultural Experiment Station Bulletin 300, "Tankage, for Spring Pigs on Legume Pasture," pages 3, 5, and 6, tables 1 and 2, Lafayette, Indiana, March 1938.

Feeding System for Spring and Fall Litters at Tifton, Georgia

Conducted by: Georgia Coastal Plains Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1935-1937.

Purpose: To compare different feeds for pork production.

Procedure and Conditions: The 1935 spring litter feeding periods were as follows:

Lot 1—April 23 to July 15.
Lot 2—July 16 to August 7.
Lot 3—August 8 to August 31.
Lot 4—September 1 to September 24.
Lot 5—September 25 to November 15.
Lot 6—November 16 to December 10.

The feeding periods for the 1936 spring litters were as follows:

Lot 1—May 5 to July 14.
Lot 2—July 15 to August 14.
Lot 3—August 15 to September 29.
Lot 4—September 30 to October 26.
Lot 5—October 27 to November 9.

Results:

CONTINUOUS FEED PROGRAM FOR HOGS AT TIFTON—SPRING LITTERS, 1935

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Number pigs to lot	38	38	41	41	41	30
Feeding period, days	84	23	24	24	52	24
Grazing crops (acres)						
Mature oats	5.4					
Otootan soybeans (no beans set) green grazing		2.2				
Grohoma sorghum (mature) and Otn. soyb. (no beans set)			3.4			
Grohoma sorghum (mature) & Spanish peanuts (mature)				4.1		
Corn (mature) and Hayseed soybeans (mature)					8.3	
Dry lot on corn and tankage						—
Supplement						
Corn (lbs.)	3958	592				5544
Tankage (lbs.)	345	31	47	177	215	155
Cottonseed meal (lbs.)	235	21	32	118	142	104
Total gain (lbs.)	1642	556	598	1324	3046	1490
Total gain per acre (lbs.)	304	253	176	323	367	—
Gain per day per pig (lbs.)	.52	.65	.61	1.35	1.63	2.07
Acres per pig for the period grazed	.142	.057	.082	.100	.202	—

CONTINUOUS FEEDING PROGRAM FOR HOGS AT TIFTON, GEORGIA, SPRING LITTERS 1936

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Number pigs to lot	56	52	52	39	9
Feeding period (days)	71	31	46	27	14
Grazing crop (acres)					
Mature oats	3.9				
Early White Dent corn (Hastings' Early) White Dent		6.			
Grohoma sorghum and Spanish peanuts			5.45		
Corn and Hayseed soybeans				8.45	
Dry lot on corn and protein supplement					
Supplements					
Corn (lbs.)	6719				832
Tankage (lbs.)	907	871	1048	467	63
Cottonseed meal (lbs.)	604	580	698	312	42
Total gain (lbs.)	3141	3210	2229	1054	137
Total gain per acre (lbs.)	805	535	409	128	—
Gain per day per pig (lbs.)	.79	1.98	.98	1.00	1.17
Acres per pig for period grazed	.069	.115	.104	.217	—

Note: A mineral mixture was self-fed.

References: Georgia Coastal Plain Experiment Station Sixteenth Annual Report 1935-1936, page 59, Tifton, Georgia, September 1936.

Georgia Coastal Plain Experiment Station Eighteenth Annual Report 1937-1938, pages 72 and 73, Tifton, Georgia, July 1938.

CONTINUOUS FEEDING PROGRAM FOR HOGS AT TIFTON, GEORGIA, FALL LITTERS 1935-36

	Lot 1	Lot 2	Lot 3
Number pigs per lot	44	44	44
Period	Oct. 22 to Jan. 10	Jan. 11 to Mar. 6	Mar. 7 to Mar. 26
Feeding period (days)	81	56	20
Grazing crop (acres)			
Corn and runner peanuts	7.9		
Runner peanuts		9.	
Dry lot on corn and tankage			—
Supplements			
Corn (lbs.)			4.49
Tankage (lbs.)	.2	.28	.45
Daily gain per pig (lbs.)	.98	1.37	1.44
Gain per acre (lbs.)	408.	374.	—
Average weight per pig on Mar. 26	207.	207.	207.

References: As on page 116.

FEED PREPARATION AND METHODS OF FEEDING

Grinding Corn for Swine

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: 1931 through 1933.

Purpose: To determine the relative value of different degrees of fineness of ground corn when compared to whole corn, as measured by gain in body weight of growing and fattening pigs.

Procedure and Conditions: This report is an average of four tests conducted using ground corn, fine, medium and coarse, compared to whole corn. The degrees of fineness were obtained by grinding corn through 3/36, 3/16 and ½ inch screens in a hammer type mill.

A ration of 1,000 pounds of corn, 200 pounds of wheat middlings, 66⅔ pounds of 60 percent tankage, 33½ pounds of old process linseed meal and 13 pounds of mineral (ground limestone 40, steamed bonemeal 40, salt 20) was fed to all lots in each test.

These tests were conducted in 1931 through 1933 using purebred Chester White, Duroc-Jersey, Poland China, and Berkshire pigs. They were evenly distributed according to breed, weight, and size through each lot. All lots in two tests were fed in dry lot, lots ¼ acre in size and all lots in two tests were fed on ¼ acre pastures of Dwarf Essex rape. All animals were fed a daily ration equivalent to 3 percent of the liveweight.

	Lot 1	Lot 2	Lot 3	Lot 4
	Fine	Medium	Coarse	Whole
Fineness modulus	2.12	2.54	3.28	9.5
Pigs fed	9.5	10.	10.	10.
Days fed	80.	79.	81.	86.
Average initial weight per pig (lbs.)	78.1	78.0	77.3	77.5
Average final weight per pig (lbs.)	190.5	192.6	188.3	180.9
Average daily feed per pig (lbs.)	4.61	4.69	4.65	4.63
Average daily gain per pig (lbs.)	1.40	1.45	1.37	1.19
Average feed per 100 lbs. gain (lbs.)	333.6	327.2	343.6	393.4

Reference: Pennsylvania Agricultural Experiment Station Bulletin 326, "Grinding Corn for Swine," pages 3, 4, 5, 6, and 7, tables 1, 2, 3, and 5, State College, Pennsylvania, March 1936.

Self-Feeding Compared with Hand-Feeding from Weaning Through Fattening Period

Conducted by: U. S. Experiment Farm.

Conducted at: Beltsville, Maryland.

Period: 1921 and 1922.

Purpose: To compare self-feeding with hand-feeding from weaning through fattening period.

Procedure and Conditions: The following breeds were used in the experiment: Duroc-Jersey, Poland China, Chester White, Hampshire, Tamworth, and Berkshire. In addition to these some grade sows and litters were on test. In most of the tests, pastures of various kinds were used. Pastures were usually rye, but a mixture of oats and some native grasses were used.

In the self-fed lots, certain feeds were constantly accessible in self-feeders to the sows and pigs during the entire period. The sows and pigs in the hand-fed lots were given twice daily all they would readily eat of identically the same feeds used in the self-fed lots. In the hand-fed lots, the young pigs had access to self-feeders placed in creeps providing supplementary feed after they had reached three weeks of age. Corn alone was provided in the self-feeders for the young pigs for the first two or three weeks. After this time the protein feeds were added.

The above conditions have to do with the feeding of pigs through suckling period up to weaning. At this time it was decided to continue this test through the fattening period.

Results:

SELF-FEEDING COMPARED WITH HAND-FEEDING FROM WEANING THROUGH FATTENING PERIOD

	Self-fed	Hand-fed
Number of pigs in tests	253	101
Average weight when farrowed (lbs.)	2.38	2.36
Average weight when weaned (lbs.)	35.71	32.61
Average gain from farrowing to weaning (lbs.)	33.33	30.25
Average age at weaning (days)	71.02	76.24
Average daily gain from farrowing to weaning	.47	.40
Average gain, weaning to beginning of test	70.96	67.15
Average number of days, weaning to beginning of test	119.54	120.49
Average daily gain, weaning to beginning of test (lbs.)	.59	.56
Average weight, beginning of test (lbs.)	106.66	99.76
Average weight, close of test (lbs.)	197.74	188.18
Average gain on test (lbs.)	91.08	88.42
Average age, beginning of test (days)	190.56	196.73
Average age, close of test (days)	266.36	289.89
Average days on test (days)	75.80	93.16
Average daily gain on test (lbs.)	1.20	.95
Average daily gain, farrowing to close of test (lbs.)	.73	.64

Reference: Farmers' Bulletin 1504, "Self-Feeding versus Hand-Feeding Sows and Litters," pages 2, 3, and 6, table 2, August 1926.

Self-Feeding Ground Corn and Soybeans and the Feeding of Same with Different Protein Supplements

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1929.

Purpose: To determine the value of self-feeding ground corn and soybeans and the feeding of same with different protein supplements.

Procedure and Conditions: All pigs were bred and raised on the Experiment Station farm and in each trial they had had the same care and feeding until the various trials were started. The practice was to worm and move the pigs on clean grazing lots as soon after weaning as possible. They were smooth, thrifty, and considered as good-to-choice feeder pigs. The breeding consisted of purebred Poland China, Duroc-Jersey, and Hampshire, with some crossbreds of these breeds. At the beginning of the experiment, the pigs weer divided into lots as nearly equal as possible in age, breeding, type, sex and quality, condition, and weight.

In soft pork studies large variations have occurred in carcasses of hogs from the same lot; therefore, it was deemed necessary to know the exact proportion of corn to beans each individual pig consumed in order to try to determine the cause of variation in firmness of carcasses, and the only way to obtain such information necessitated the grinding and thorough mixing of the feeds in known proportions. Hence, the work was carried out on that basis.

This work consisted of the addition of a protein supplement to the corn and soybean ration in order to see if some was profitable and if so, what source of protein supplement would give the most economical gains. All feeds were ground and mixed thoroughly in definite proportions. Each group of pigs was self-fed in dry lots and had free access to the following mineral mixture:

10 parts bonemeal.
10 parts ground limestone.
2 parts salt.

Results:

SELF-FEEDING GROUND CORN AND SOYBEANS AND THE FEEDING OF SAME WITH DIFFERENT PROTEIN SUPPLEMENTS

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Ration—(Self-fed in dry lot)	Corn 6 parts Mammoth Yellow beans 1 part	Corn 6 parts Virginia beans 1 part	Corn 6 parts Mammoth Yellow beans 1 part M.P.F. 0.3 part	Corn 6 parts Mammoth Yellow beans 1 part D.B.M. 0.4 part	Corn 6 parts Mammoth Yellow beans 1 part C.S.M. 0.341 part
Number of hogs	10	10	10	10	10
Length of feeding trial (days)	63	63	56	56	56
Average initial weight (lbs.)	96.8	96.5	99.	99.1	98.7
Average final weight (lbs.)	190.3	196.2	207.1	224.1	202.2
Average daily gain per hog (lbs.)	1.48	1.58	1.93	2.23	1.84
Feed consumed per 100 lbs. gain					
Corn (lbs.)	325.72	322.00	282.24	269.42	292.10
Beans (lbs.)	54.28	46.00	47.03	44.90	48.68
Protein supplement (lbs.)	—	—	14.10	17.96	16.63
Mineral mixture (lbs.)	7.59	5.71	2.40	1.36	2.41

M.P.F.—Marine protein feed; D.B.M.—Dried buttermilk; C.S.M.—Cottonseed meal.

Reference: Mississippi Agricultural Experiment Station Bulletin 283, "Grazing and Feeding Trials with Corn and Soybeans for Pork Production," pages 3, 7, and 8, table 5, State College, Mississippi, July 1930.

Self-Feeding Shelled Corn and Soybeans Free Choice and Hogging Down Corn and Soybeans

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 59 days, September 30 to November 27, 1928.

Purpose: To determine the value of self-feeding shelled corn and soybeans free choice and hogging down corn and soybeans.

Procedure and Conditions: All pigs used in the following experiments were bred and raised on the Experiment Station farm and in each trial they had the same care and feeding until the various trials were started. The practice was to worm and move the pigs on clean grazing lots as soon after weaning as possible. They were smooth, thrifty, and considered good-to-choice feeder pigs. The breeding consisted of purebred Poland China, Duroc-Jersey, and Hampshire, with some crossbreds of these breeds. At the beginning of each experiment, the pigs were divided into lots as nearly equal as possible in age, breeding, type, sex and quality, conditions and weight.

Results:

SELF-FEEDING SHELLED CORN AND SOYBEANS, FREE CHOICE, AND HOGGING DOWN

	1 Dry lot	2 Dry lot	3 Dry lot	4 Dry lot	5 Dry lot	6 Hog.	7 Hogged
	Corn and tankage	Corn and M. Yellow beans	Corn and Laredo beans	Corn and Manchu beans	Corn and M. Yellow beans	Corn and M. Yellow beans	Corn and Laredo beans
Number of hogs	8	8	8	7	7	12	12
Average initial weight (lbs.)	101.87	101.25	101.75	101.14	102.57	101.75	96.41
Average final weight (lbs.)	217.62	187.25	186.37	175.00	177.57	206.75	175.60
Average daily gain (lbs.)	1.96	1.45	1.43	1.25	1.27	1.77	1.34
Feed consumed per 100 lbs. gain:							
Corn (lbs.)	311.77	229.65	271.93	315.08	277.33	—	—
Tankage (lbs.)	37.68	—	—	—	—	—	—
Mammoth Yellow beans (lbs.)	—	112.50	—	—	104.57	—	—
Laredo Yellow beans (lbs.)	—	—	87.00	—	0.0*	—	—
Manchu Yellow beans (lbs.)	—	—	—	52.22	—	—	—
Proportion of corn to tankage	8.26:1	—	—	—	—	—	—
Proportion of corn to soybeans	—	2.04:1	3.12:1	6.03:1	2.74:1	—	—

*Only one pound of Laredo soybeans was consumed during the feeding test.

Reference: Mississippi Agricultural Experiment Station Bulletin 283, "Grazing and Feeding Trials with Corn and Soybeans for Pork Production," pages 3, 6, and 7, table 4, State College, Mississippi, July 1930.

PART VI

Killing, Curing and Storing Pork

Fresh pork is a highly perishable product. Without proper handling, preparation, refrigeration, curing and storage, a wholesome product cannot be had. By careful elimination of waste and spoilage the advantage of proper handling of hogs on the farm can be realized. Success in preparing meat depends on strict attention to the methods used.

There are many different ways in which to prepare pork products. The most desirable one for each farmer is that which best suits his family or locality. However, certain general rules for cutting and curing should be observed by all.

Equipment: Certain tools are essential in butchering hogs, illustrated in figure 35.

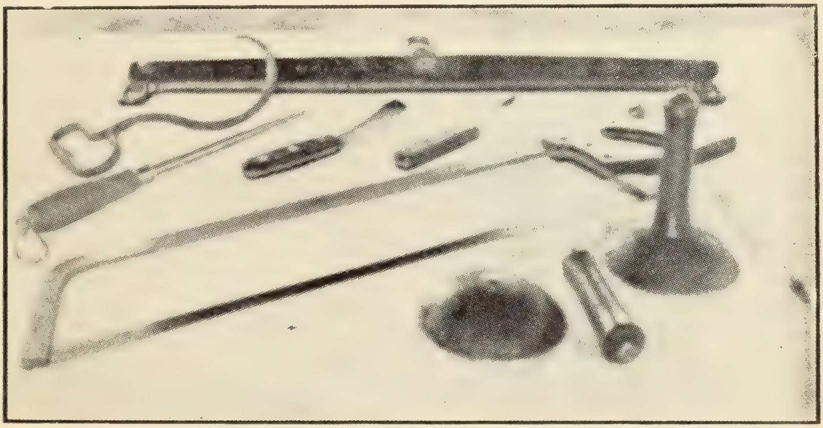

Figure 35. Equipment for use in slaughtering and dressing hogs; gambrel (singletree), hook, smooth steel, skinning knife, boning knife, saw, bell-shaped hog scrapers and thermometer.

In addition to these tools, scalding barrel and scraping table are essential.

Care of hogs before slaughtering: The care of an animal just before slaughtering has much to do with getting a good "stick." This is important because meat from a well bled hog keeps better than from a hog which has not been bled properly. A hog bleeds more thoroughly and dresses more easily after a 24-hour fast, but it should be given all the water it will drink. Running the animal or wrestling with it often causes an abnormal temporary temperature. Animals should not be killed in this condition as the meat is likely to be bloody, sometimes referred to as "firey." Such meat looks bad and spoils easily.

Sticking: Killing the hog should be done as humanely as possible and in a way that will insure a thorough drainage of the blood. Stunning may be done by striking it one sharp blow with an ax or other heavy blunt instrument or by shooting directly at a point in the forehead, midway between the eyes and slightly above. If possible the stunning should be made effective with the first trial.

Some stick the animal without stunning and it is highly recommended and will give a more complete drainage of blood when stuck. In sticking, place the hog squarely on its back, take a position squarely in front of the hog and open the skin for a distance of about 3 inches in front of the breastbone, then insert the knife, edge downward, straight in toward the breastbone, not downward as is often done. When the breastbone is reached, follow downward with the point of the knife until the knife slips under the breastbone, then push the knife in about 1 inch and direct the cut first downward toward the backbone, then forward toward the heart as illustrated in figure 36.

It is unwise to stick the heart, because it should be allowed to pump out the blood as long as possible.

Scalding: On the farm where it is difficult to reheat the water promptly, the temperatures of 155° to 165° F. often must be used at the beginning so that the water will not become too cold before the hog is completely cleaned. In using water as hot as this, care must be taken to keep the hog in motion while in the water and to pull from the barrel and give it frequent chances to cool to lessen the danger of setting the hair. Test and remove from water as soon as hair and scurf slips easily.

Scraping: When the hog has been completely scalded one man should

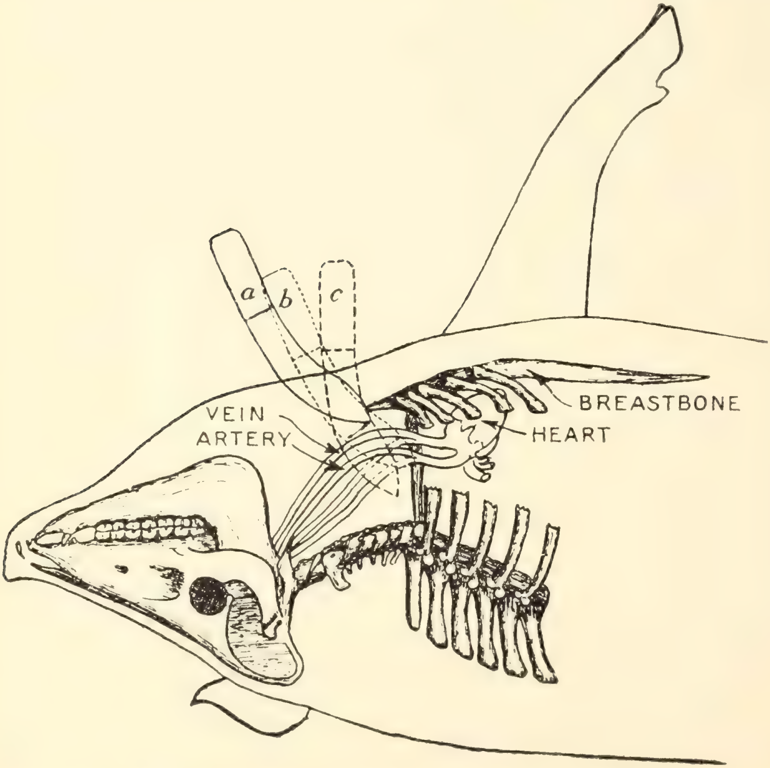

Figure 36. The three positions of the knife in sticking a hog: (a) the knife inserted in the fat; (b) the second position placed the knife above the artery; (c) the final position after the downward thrust has been made and the artery severed.

grip the hind legs with both hands and twist off the hair and then pull off the dew claws and toes. At the same time another man should scrape the forelegs and head. From these points scrape the entire body. Scraping should be done as quickly as possible. After the hair has been removed the carcass should be cleaned by rinsing with warm water and re-scraping, being careful not to cut the skin. Sometimes a blow torch and wire brush will be very useful in singeing and in scraping the head and feet. After this is done the carcass should be rinsed with cool water and shaved.

Removal of Internal Organs: Opening the hog carcass and removing the internal organs are really simple operations, particularly if the animal has been kept off feed for 24 hours before slaughtering. There are many different methods, but the following steps should be understood by the beginner:

(1) Insert the skinning knife, edge side into the sticking place and cut up through the full length of the breastbone as illustrated in figure 37, A.

(2) Begin at the other end of carcass and cut down between the hams, being sure to keep the knife in the center. As the hams open the white membrane which marks the exact middle can be seen. Follow this if possible to the pelvic bone. Sometimes it is necessary to use a saw to divide the pelvic bone. While dividing the pelvic bone care should be taken to avoid puncturing the urinary bladder which lies just below. Insert handle of the knife in opening made in splitting the hams, with the point of the knife pointing outward. Guard the heel of the blade with the forefinger and thumb of the right hand and cut down the medium line of the belly until this cut joins the split breastbone as illusrated in figure 37, B.

(3) Allow intestines to roll out and hang by the natural attachments. Raise the bung by slipping the knife into the pelvic cavity and loosen the bung from the fat on both sides and at the back. Pull it down and toward the kidneys, being careful to cut it free from the kidney fat as illustrated in figure 38, A.

(4) At this point the operation is almost completed and no difficulty need be anticipated. With the left hand, grasp the intestines firmly just below the kidneys at the point where they appear to be attached to the backbone. Push down slowly until they loosen from the back. Free the liver by running the finger of the right hand behind it and pulling it away from the back. Still holding the intestines in the left hand, cut through the diaphragm to the backbone as illustrated in figure 38, B.

Extend the cut around the white fibrous portion of the diaphragm which is parallel to the ribs, to the breastbone and down the breastbone to the throat. This last cut loosens the heart and lungs in the chest cavity. It may sometimes be necessary to cut the back artery from the backbone, thus permitting the left hand to pull the entire offal out of the carcass. The gullet is still attached to the throat, but one cut of the knife will free it.

(5) Rinse the body cavity with cold water. Split the carcass down the center of the backbone with a saw, remove the leaf fat by loosening it where it is attached to the diaphragm at the last rib and strip it up and out as illustrated in figure 39.

Chilling the Carcass: The tissues of many freshly slaughtered hog carcasses contain bacteria that are capable of spoiling the meat unless their growth is promptly checked. This problem can practically be solved by chilling the fresh

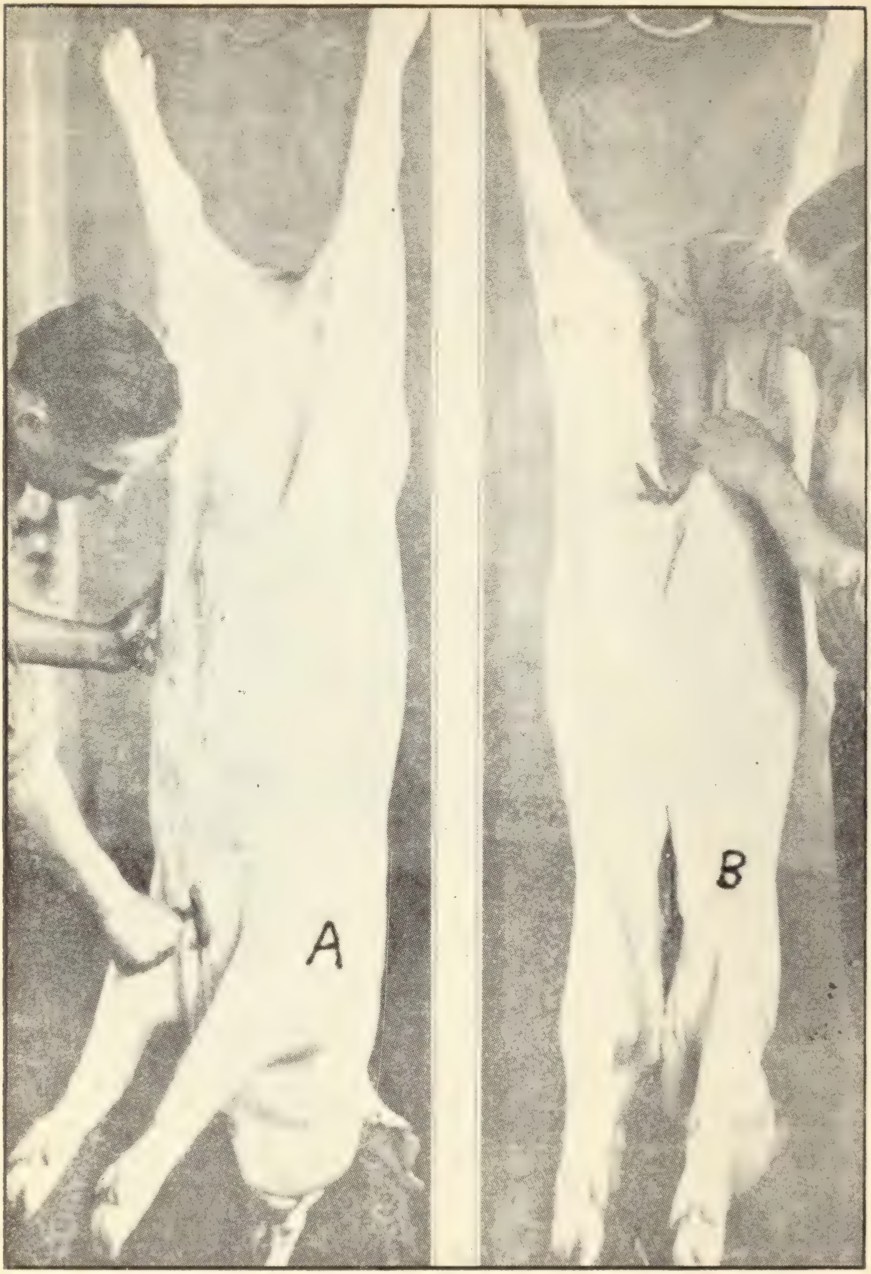

Figure 37, A. In splitting the breastbone, if the handle of the knife is slanting up with the point down there is little danger of cutting up too far and opening the stomach.

B. Under this method of opening the carcass there is no danger of cutting the intestines or stomach.

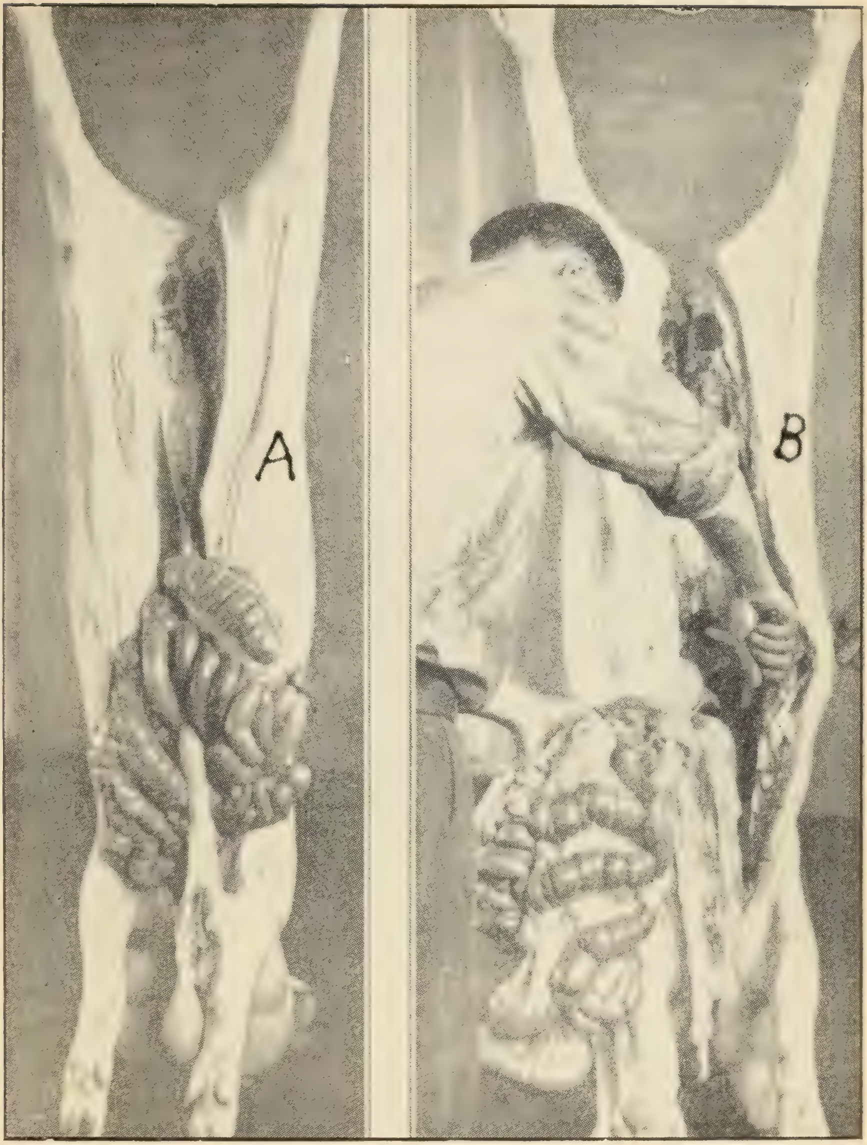

Figure 38, A. The internal organs will not fall unless the animal was fed shortly before slaughter.

B. In removing the intestines, grasp them carefully and firmly so they will not tear and fall.

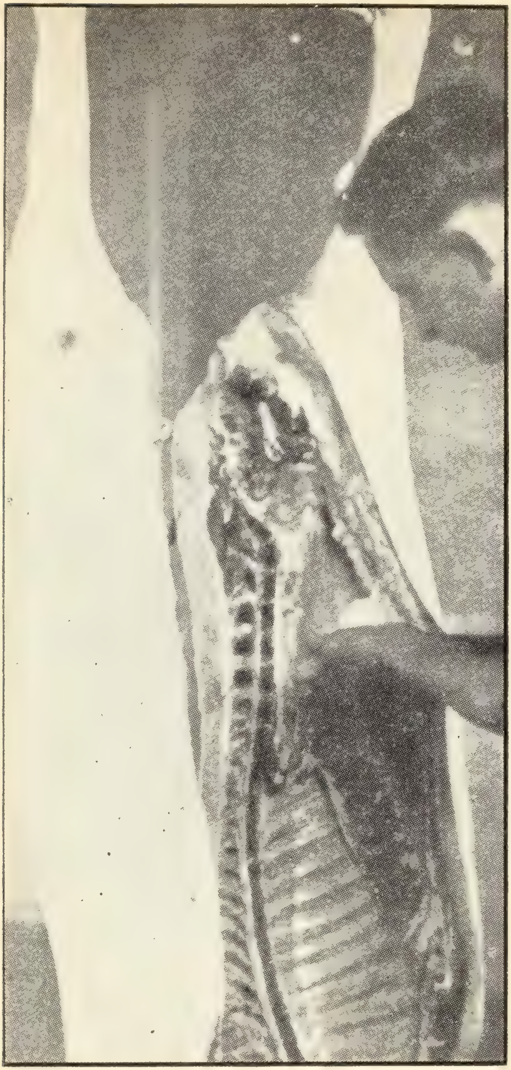

Figure 39. The warm leaf fat is pulled out by loosening it at the rib end and fisting it up and out

warm carcass to a temperature of 34° to 36° F. as soon as possible after slaughtering, preferably within 12 to 18 hours, and by holding the meat at 36° to 40° F. while it is curing. Care should be exercised to prevent the carcass from freezing. Chilling greatly facilitates cutting and trimming the carcass, and is necessary to cure properly.

Cutting the Carcass. Figure 40 shows the standard division of cuts in a pork carcass.

There is not one best method of cutting the pork carcass. The choice depends on how the pork is to be used. If it is to be sold locally the cuts should conform to local preferences.

Trimming Pork Cuts: All meat to be cured should be trimmed smoothly and evenly. Care should be exercised to remove all blood spots, to be looked for especially in the shoulder. The brisket and ragged neck pieces should be cut from the shoulder, tail and flank from the ham, and the uneven edges from the bacon strip. The excess fat on the hams and shoulder may be removed, though the pieces are stored more satisfactorily in summer if not skinned. The bacon strip should be flattened out with the hands or with the sides of a cleaver, and square on all 4 sides. The jowls and fat back, if these cuts are to be cured, should be treated in the same way. Figure 41 shows poorly trimmed and well trimmed cuts

Curing

Curing Pork: Curing is a race between the multiplication of spoilage bacteria in the curing pork and the penetration of the preserving salt. It takes weeks for the salt to reach sufficient concentration to protect the center

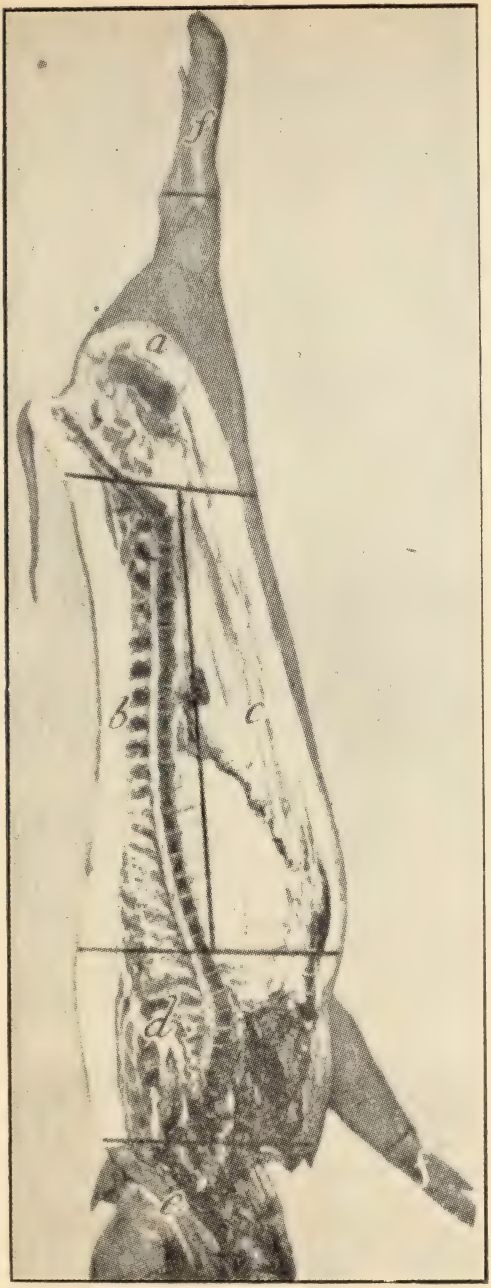

Figure 40. Cuts of pork: (a) ham; (b) loin; (c) bacon strip; (d) shoulder; (e) head; (f) feet.

of hams and shoulders. Low temperatures are the best means known today to prevent the growth of spoilage organisms in meat until the salt has completed the task assigned to it. Temperatures ranging from 36° to 38° F. have been found most satisfactory for curing. At the same time, much meat is cured on the farm at temperatures above 40° and even up to 50°, although much meat may be lost at these high levels.

Ingredients used in curing meat are (1) Salt, which dries and preserves the meat and checks the development of putrefactive bacteria. A good grade of clean, common dairy or table salt is desirable. (2) Sugar is used mainly to lessen the harshness of the straight salt cure and to improve the flavor and taste of the meat. Brown or cane sugar may be used. (3) Nitrates: Saltpeter (nitrate of potash) preserves and dries the meat, but is used almost entirely because it effectively fixes the bright red color of the meat. Nitrate of soda (Chile saltpeter) is a little stronger and 1.7 ounces of nitrate of soda will replace 2 ounces of saltpeter. It is undesirable and unwise to use more of either saltpeter or nitrate of soda than is recommended. (4) Pepper is sometimes dusted on the cured meat to add flavor.

There are two recommended methods of curing:

(1) **Brine Method.** The standard curing mixture for each 100 pounds of meat is 8 pounds of salt, 2 pounds of sugar, 2 ounces of saltpeter, and 4½

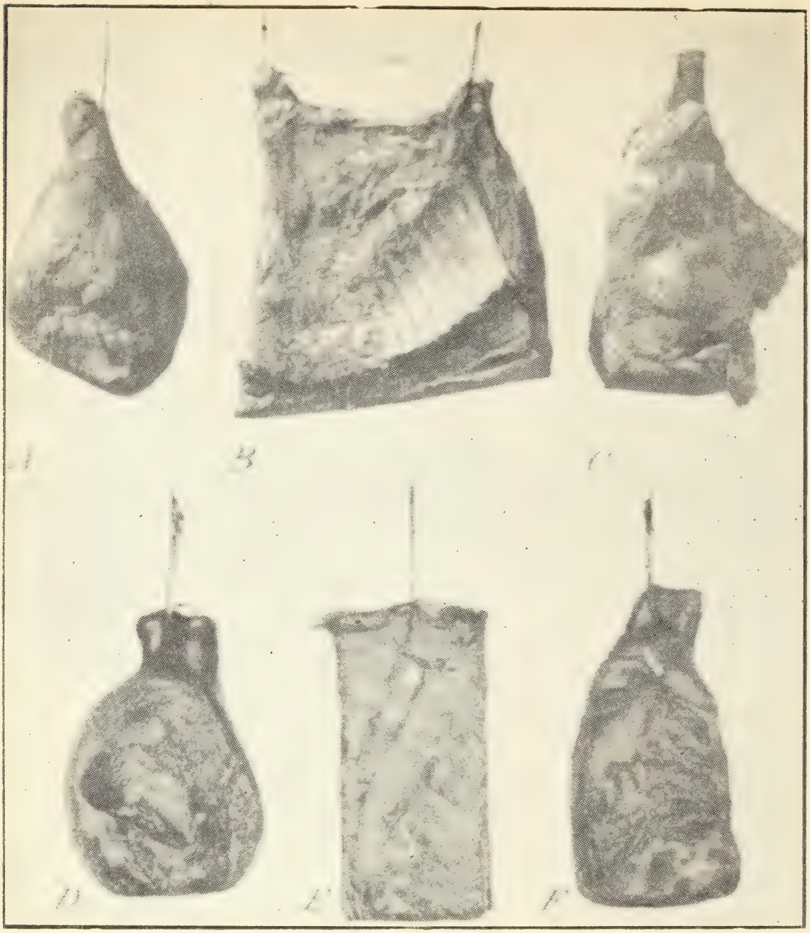

Figure 41. Poorly trimmed ham (a), bacon (b), and shoulder (c). Similar cuts well trimmed: d. e. f.

to 6 gallons of water. Weigh the meat and mix the required amount of curing ingredients.

The standard curing mixture dissolved in 4½ gallons of water will make a brine that tests 75° on the salinometer. This is excellent for curing hams and shoulders. When 5½ gallons of water is used, the weaker brine, testing 65°, will produce a desirable mild bacon.

Pack hams and shoulders closely together, skin side down in a crock or barrel. Pour in the cold 75° brine until the pack begins to shift or float a little, then add a clean weight, just heavy enough to keep the meat below the surface of the brine.

On the fifth, fifteenth, and thirtieth days after being put down, the hams and shoulders should be removed and placed in another barrel and re-covered with the same brine or they and the brine may be removed and replaced in the same barrel. This remixes the brine and insures its coming in contact with all parts of each cut.

The bacon strips are usually packed, skin side down; each piece should be crosswise of the piece below it. Jowls and shoulder butts may be used to fill any unoccupied space. The milder 65° brine is frequently used for bacon. Removing this meat and remixing the brine on the third and tenth day is usually sufficient.

Hams and shoulders are usually held in brine 4 days per pound; that is, a 15 pound ham will not be removed from cure until the 60th day and it is probably better to allow the 4- to 6-pound picnics 25 to 30 days in cure. Bacon can be cured in 1½ to 2 days per pound.

If the brine should become ropy it should be changed. Remove the meat and scrub thoroughly with a brush and warm water and repack in a clean and scalded barrel. The new brine made after the original recipe should be diluted to as near the same saltiness of the old brine as possible. If the hams and shoulders have been in cure a week, use 70° brine instead of 75°; if more than two weeks use 65° brine. Maintain the original curing schedule. This process may not save the meat, but it is the only course available.

(2) **Dry Method.** The following curing mixture is recommended: For each 100 pounds of trimmed pork use 6 to 8 pounds of salt, 1½ to 2 pounds of sugar and 2 ounces of saltpeter. This is the well-known 8-2-2 recipe.

Mix the ingredients thoroughly and divide into two equal parts by weight. Use one part for the first rubbing, ½ of the remainder on the third day and the other ½ on the tenth day.

The First Rubbing: Sprinkle a little of the mixture in the bottom of a barrel and put each ham and shoulder into the pan of curing mixture and rub it thoroughly. Force some salt into the hock and along the cut face of the butt. Cover the face of the butt with the mixture and lay the pieces carefully in place. Repeat this process on each successive rubbing. The pieces on top of the original pack should be at the bottom when the meat is re-salted.

The same curing mixture with the salt reduced to five pounds will dry-cure 100 pounds of bacon. Re-salting on the third day will be sufficient.

Two days per pound is the standard time for the dry method; however, it is usually sufficient to keep 8 to 10 pound hams in the curing mixture for 25 to 30 days.

Smoking Cured Meat: Cured pork is smoked primarily to give the meat its familiar color and flavor and to evaporate some of the moisture from it. Smoking tends to seal the surface and helps delay the development of rancidity in the fat. Relatively high smoke-house temperatures (100° F. or above) with a light smoke will speed up the drying. Lower temperatures (80° to 110° F.) with a dense fog or smoke will intensify the smoke flavor in the meat. When meat is taken from the curing container it should be washed in warm water to remove the excess salt and allowed to drain and dry over night before smoking is started.

Green hickory wood and sawdust are the standard fuels for smoking meat. Other hardwood such as oak, apple, maple or ash will be satisfactory.

A distance of 10 feet between meat and fire is sufficient. If the distance is only 5 or 6 feet an inverted tube or metal shield should be placed above the fire to deflect the direct heat. Smoking should be continued until the meat has the desired color.

Storing

Storage is possibly the most important problem faced in handling pork in Mississippi. Cured pork is sometimes stored in rooms with low temperatures. It has been found by experimental work conducted at Maryland Experiment Station, also at Mississippi Experiment Station, that meat stored in rooms with low temperatures prevents the desired aging and development of the proper flavor and in some cases the meat becomes undesirable for consumption after a long storage period. It has been found that meat ages better at a temperature of around 108° F., requiring about a 10-week period. It has been found that a temperature ranging from 90° to 120° F. is the most desirable temperature for aging cured hams. The average farm smokehouse, which may be improved by the use of screen wire to prevent insects from entering, has been found to be a very satisfactory place to store meat. Protection from insects may be afforded by wrapping the meat with brown paper and sacking.

BULLETIN No. 352 NOVEMBER, 1940

Factors for Success on Starch Sweetpotato *and* General Farms

In Jones County, Mississippi, 1939

By

MARVIN GUIN, D. W. PARVIN and A. J. HUFF

SWEETPOTATOES STORED IN RECEIVING BINS AT THE STARCH FACTORY, READY TO BE PROCESSED.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
State College, Mississippi

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SUMMARY

This study of 100 farms in Jones County, Mississippi, covers one year—1939—in which farming was below average because of low yields of crops in general. The average total investment per farm was $3,930 and usually ranged from $2,000 to $6,000. The farms which grew starch potatoes had a higher per cent of their total capital investment in operating capital than did the group of comparable farms not growing starch potatoes.

The average size farm surveyed was 130 acres, of which 48 acres were in crops. Corn and cotton were grown on all farms and constituted 50 per cent and 20 per cent, respectively, of the total crop acres. Sweetpotatoes made up 6 per cent of the total crop acres. The number of acres of starch potatoes to grow appears to depend upon price relationships, importance of other enterprises, and available labor.

The average farm in the region surveyed returned 4.3 per cent interest on capital invested, ranging from 7.4 per cent on starch potato farms to 1.1 per cent on non-starch potato farms.

Cotton and starch potatoes were the two most important crops, representing 54 per cent and 19 per cent, respectively, of the total crop receipts.

Sales from livestock and livestock products amounted to $197 on the starch potato farms as compared to $88 on the farms not growing starch potatoes.

The average total farm receipts for the group of farms was $1,081, ranging from $89 on a one-horse cotton farm with no starch potatoes to $8,495 on a highly diversified farm with $1,200 cash receipts from starch potatoes.

Cropper labor and fertilizer were the most important items of expense on all farms.

The products furnished the family by the farm averaged $355, and did not vary greatly on the two groups of farms.

The average labor income on all farms was $157, ranging from $295 on the starch potato farms to $23 on farms which did not grow starch potatoes. Labor income varied from —$550 on a farm with only cotton as a cash crop to $1,983 on a large diversified farm with starch potatoes. The majority of the farms fell within the range of —$249 to $249.

A study of the factors affecting the profits indicates that the farmers which spent less time on cotton and livestock and more time on starch potatoes and other crops used their labor and other factors of production more efficiently and obtained more profits per farm.

Starch potatoes required a few more man hours per acre than did cotton; starch potatoes averaging 123 man hours, and cotton 108 man hours. The peak load of man labor in the production of starch potatoes is during transplanting and harvesting periods.

The average receipts per acre for cotton and cottonseed was $30.37, the average expenses were $24.57 leaving a net return of $5.80 per acre. The average receipts per acre of starch potatoes were $49.80; the net returns $7.92 per acre. The net returns from starch potatoes exceeded that of cotton by $2.12 per acre.

Farms growing starch potatoes had much higher receipts, farm income, labor income, labor earnings, and percent returned to capital, than did the group of comparable farms that did not grow starch potatoes. The starch potato farms were more diversified, as shown by larger receipts from livestock and livestock products and crops other than cotton. It appears that in general the more progressive farmers grew starch potatoes and as a group they would have had a higher income than the other group, even though they had not grown starch potatoes.

*Factors for Success on Starch Sweetpotato and General Farms in Jones County, Mississippi, 1939**

INTRODUCTION

As a result of the present low price of cotton, and restricted acreage of cotton due to the AAA program, farmers are seeking other sources of cash income. By the trial-and-error method, farmers in Mississippi have made effort to adjust their systems of farming to include those enterprises which pay best. With changing economic conditions in farming from a relatively self-sufficing economy to a more specialized and commercialized economy, farmers are eager to shift to more profitable enterprises. Sweetpotatoes for starch production are thought by some to help fulfill this need. The recent increased interest in starch potato production is the result of a growing recognition that every possible effort should be made to increase farm incomes.

During the period 1924-1928 sweetpotatoes ranked second to cotton as a cash crop in Mississippi. The sweetpotato is the most important vegetable crop produced in the Southern States, and Mississippi is one of the leading sweetpotato producing states.

It is most important to know the economic aspects of, and to direct consideration to some of the economic consequences which may flow from, this new development of sweetpotato production for starch. According to the 1939 production of starch at Laurel, it would require about 177 similar plants to make as much root starch as the United States annually imports.[1] According to the United States Census, the acreage of sweetpotatoes in Jones County has recently increased 67 per cent, or from 1,592 acres in 1929 to 2,656 acres in 1934.

Objectives

In this study an attempt is made to accomplish four objectives. The first is to find out in detail the services rendered, the practices followed, and the costs involved, so far as ascertainable, in the production and marketing of the several farm commodities produced. A second purpose is to study farm organization and operations on typical farms in the Laurel area to determine the effect of sweetpotato production for the Laurel Starch Plant on farm income. The third objective is to determine the relation of prevailing farm practices to farm income. The final objective is concerned with the improvements which may be made in the production and marketing facilities and services.

Materials and Methods

Detailed records of the farm business of 100 farm owners were obtained by the survey method in the fall of 1939 in Jones County. These farms were selected with the assistance of the management of the starch plant, and are representative of conditions in the area generally. Fifty, or one half, of the farms surveyed grew two acres or more of potatoes for the starch plant. Fifty comparable farmers, who did not produce starch potatoes, were surveyed, analyzed, and compared with potato growers. Data for the year ending December 31, 1939, were obtained relative to farm receipts and expenses, inventories, cropping systems, and other farm practices with special reference to seasonal costs and returns in producing sweetpotatoes.

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*Acknowledgment is given to Mr. S. A. Robert, State B.A.E. Representative, State and Local Planning, Bureau of Agricultural Economics, who rendered valuable assistance in tabulating the efficiency factor of the study; and to Mr. W. S. Anderson, of the Horticulture Department of the Mississippi Experiment Station, for suggestions in setting up the study.

[1] Knight, Henry G. Manufacturer's Record, p. 40, Feb. 1937.

Definitions of Terms

Acres operated: The total amount of farm land operated as a unit.

Acres in crops: The number of acres of land used for crops during a season or year.

Acres of crops: The number of acres of crops planted or harvested during a year. If double-cropping is practiced, the acres of crops will exceed the acres in crops.

Farm capital: The value of the real estate, livestock, equipment, feed, and other supplies.

Farm receipts: The receipts from crops, livestock, crops on hand for sale at end of year, livestock products sold, increase in inventory of livestock and in real estate and equipment, government payments, and rent. Household and personal items are not included.

Farm expenses: Farm expenses actually incurred, such as for fertilizer, ginning, repairs, decrease in feed and livestock inventories, and in equipment, and the value of unpaid family and hired labor.

Farm income: The difference between the total farm receipts and total farm expenses.

Labor income: The farm income less 4 per cent on the average investment. Labor income is what a farmer receives for his year's work in addition to interest on his investment, all farm expenses, having a house to live in and farm products to use in the home.

Labor earnings: The labor income plus the value of the products furnished the family by the farm. It represents the earnings of the labor of the operator.

Products furnished the family by the farm: The value of the food products and fuel furnished directly by the farm toward the family living. The value of the use of the house is included.

Per cent return on investment: The farm income less the estimated value of the operator's labor, expressed as a percentage of the average investment.

Animal unit: A mature horse or cow or the equivalent in other livestock based upon the amount of feed consumed and manure produced. Two calves, heifers, or colts; seven sheep, fourteen lambs; five hogs, ten pigs; and one hundred hens are also considered as being the equivalent of an animal unit.

Productive animal units: Includes all livestock, except workstock.

Man equivalent: The total months of labor done on the farm divided by 12. The family labor on the farm is expressed in its equivalent of man time.

Days of productive work: The average amount of productive work accomplished in a 10-hour day by a man or horse working under average conditions.

Days of productive work per man: It is determined by dividing the total man days of productive work by the man equivalent.

Days of productive work per horse: It is determined by dividing the total horse days of productive work by the number of workstock.

Operating capital: All capital other than capital invested in land and buildings.

Crop index: The weighted average yield of crops of each farm expressed as a percentage of the average yield of the area.

Price index: Expresses on a percentage basis the prices received by a particular farmer as compared with those received by all farmers included in this study.

Location and Description of Area Studied

Jones County is located in the southeastern part of Mississippi in the longleaf pine area (see Fig. 1). The topography varies from a rolling area in the eastern part to high ridges and bottom land in the western portion. The rolling land and ridges are too steep for cultivation unless terraced.

The red, well drained soils of the county (Ruston, Orangeburg, and Greenville) are found in the western section and are the better soils of the county. These soils are considered excellent for cotton, corn, and sweetpotatoes. The heavy and poorly drained soils (Norfolk and Susquehanna) are poor soils for agricultural purposes. Practically all of the soils in the county are deficient in nitrogen, and most are deficient in phosphate and potash.

Rainfall in Jones County for the 1939 crop year was 51.2 inches, or 9.6 per cent below the normal average; however, during the first six months of the year the rainfall was 11.2 per cent higher than normal.[2] Frequent spring rains delayed the preparation of the ground for sweetpotatoes and other crops.

Jones County is served by two national and two state highways, traversing the area from north to south and east to west. These are connected by a network of gravel, dirt, and hard surfaced county roads, thus making it possible to reach all parts of the county in all weather. The county is well served by railway transportation and a system of truck lines which connect the county with larger southern markets.

Laurel, one of the county seats, is sometimes known as the "Chemurgic City." The Federal Emergency Relief Administration granted the Mississippi Relief Administration $172,000 in 1934, for the purpose of establishing at Laurel an Emergency Relief Project for the manufacture of starch and by-product pulp from sweetpotatoes, by means of a process developed by the United States Department of Agriculture.[3] The plant was operated by the Department of Agriculture, through the Resettlement Administra-

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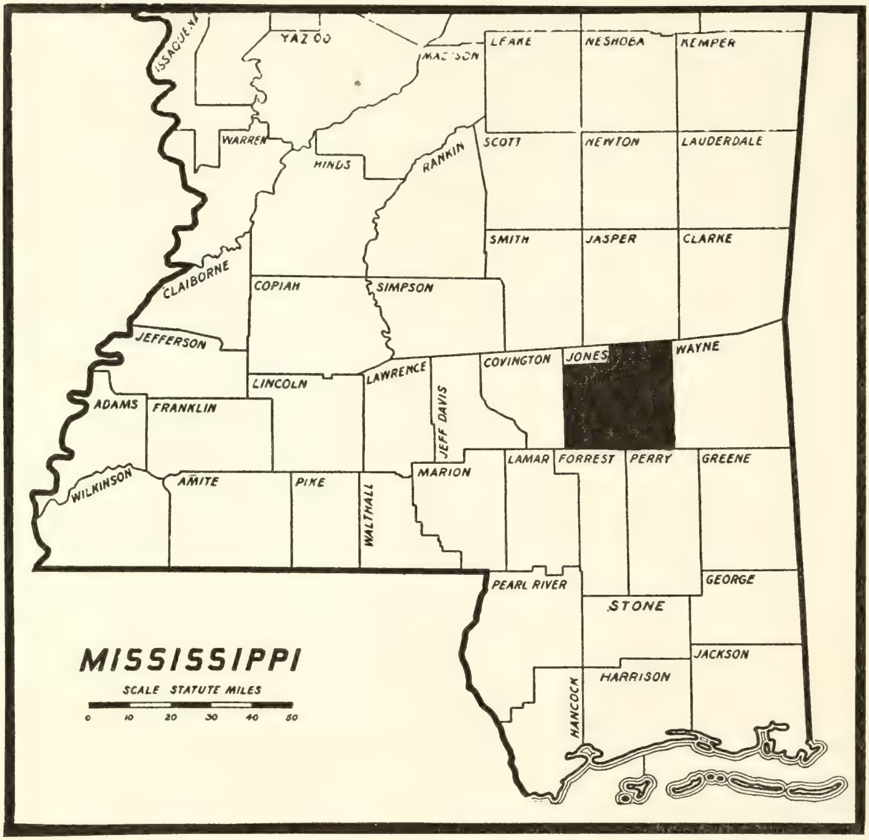
[2] Climatological data, p. 51, 1937.

[3] Memorandum of Agreement governing the establishment of Emergency Relief, Sweet Potato Starch Plant at Laurel, Mississippi, August 17, 1934.


MISSISSIPPI
SCALE STATUTE MILES
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LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
LINCOLN
LAWRENCE
JEFF DAVIS
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
MARION
PEARL RIVER
GEORGE
STONE
JACKSON
HANCOCK
HARRISON

Figure 1.—**LOCATION OF THE AREA IN WHICH THE SURVEY WAS MADE.**

tion and the Farm Security Administration, until the title was transferred in 1938, to Sweetpotato Growers, Incorporated, a farmer's cooperative operated under the trade name of The Laurel Starch Plant. It is now operated by this cooperative, operating funds being loaned by the Farm Security Administration.

Twenty-five thousand bushels of starch sweetpotatoes were received by the plant in 1934, and the estimated average yield of potatoes was 100 bushels per acre.[4] The yield per acre and total production increased steadily until in 1938 the starch plant received 165,000 bushels of potatoes with an estimated yield of 200 bushels per acre. In 1939, the plant received 265,000 bushels of potatoes and manufactured 2,700,000 pounds of starch.

Present Agriculture

A summary of certain of the major characteristics of the agriculture of Jones County is given in table 1. Comparable State data are also shown to indicate the relative position of Jones County and the agriculture of the State generally for the year 1934.

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[4] Data secured from Laurel Starch Plant.

In many respects the agriculture of Jones County is typical of that of the State. Cotton and sweetpotatoes were the only significant cash crops; the remainder of the cropland was devoted largely to the production of feed, primarily for workstock and livestock for home use. The yield of cotton and the value per acre of land and buildings in Jones County was about the same as the average for the State. In 1934, approximately 61 per cent of the land was in farms and 36 per cent of the farm land was in crops. Of the cropland, 28 per cent was in cotton, 47 per cent in corn, 9 per cent in hay crops, 3 per cent in sweetpotatoes, and 5 per cent in other crops. The total land area per farm and the total cropland per farm was about the same as that for the State.

The proportion of farms operated by tenants and of farm land operated by croppers in Jones County was smaller than that of the State. A smaller proportion of the farm population was colored than in the State generally; however, the proportion of colored tenants was very much larger than the State average.

The number of horses and mules per 100 acres of farm land in Jones County was less than half of the State average, while the number of cattle, swine, and chickens per 100 acres of farm land was about the same as the State average.

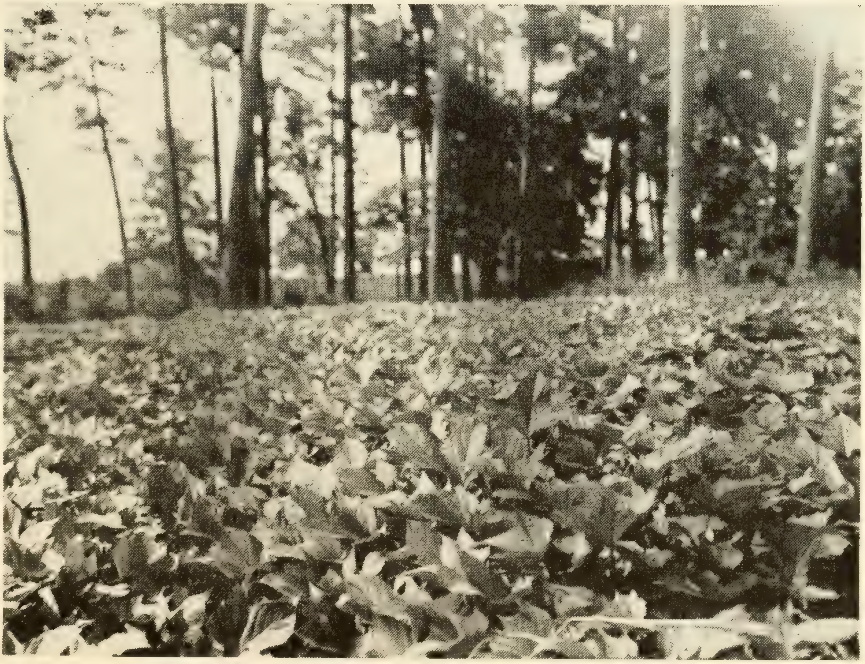

Figure 2.—"NEWGROUND" FIELD OF SWEETPOTATOES APPROACHING MATURITY.

Table 1. Comparative Summary of Selected Data Pertaining to the Agriculture of Jones County, and of the State, 1934[1]

Item		Jones County	State of Mississippi
Proportion of approximate land area in farms	per cent	60.7	66.2
Proportion of farm land in cropland	per cent	35.5	38.9
Proportion of farm land in cotton	per cent	9.8	12.9
Proportion of cropland in cotton	per cent	27.7	33.0
Proportion of cropland in corn	per cent	46.5	39.6
Proportion of cropland in hay crops	per cent	9.5	10.0
Proportion of cropland in sweetpotatoes	per cent	2.8	1.3
Proportion of cropland in other crops	per cent	5.0	4.2
Proportion of cropland idle or fallow, failure	per cent	8.5	11.9
Average yield of cotton lint per acre	pounds	203.0	221.5
Cotton production per 100 acres farm land	bales	40.6	44.3
Value per acre of farm land and buildings	dollars	19.10	18.87
Proportion of farms operated by:			
Tenants	per cent	43.2	69.8
Proportion of farm land operated by:			
Croppers	per cent	12.0	16.8
Other tenants	per cent	15.5	23.4
Proportion of rural-farm population colored	per cent	17.9	53.9
Proportion of tenants colored	per cent	24.6	6.8
Livestock per 100 acres of farm land:			
Horses and mules[2]	number	2.1	4.6
Cattle[3]	number	7.2	7.1
Swine[4]	number	4.0	4.7
Chickens, over 3 months old	number	2.7	2.9
Total land area per farm	acres	66.9	63.0
Cropland per farm	acres	23.7	24.5

[1] Data obtained from United States Census report 1935, unless otherwise stated.
[2] Mules and horses (all ages).
[3] Cattle and calves (all ages).
[4] Swine (all ages).

While the number of farms in Jones County has increased steadily from 1,600 in 1900 to 4,000 in 1935, the average size of farm has decreased from 140 to 67 acres in the same period. The proportion of white farmers has not varied considerably in the past fifteen years. In 1935 white farm operators represented 83 per cent of the total, and 54 per cent of the farm operators were owners. This percentage has also varied only slightly.[5] Only 12 per cent of the farm land operators were sharecroppers in 1935.

Although large farms were not uncommon, the greater proportion of the

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[5] U. S. Census of Agriculture.

Table 2. The Number and Average Size of Farms, Color, and Tenure of Operators, Jones County, Mississippi, 1900 to 1935[1]

Year	Total farms	White farmers	Colored farmers	Full owners	Others	Average Size of farm (acres)
1900	1,561	1,366	195	1,201	360	140
1910	2,688	2,232	456	1,721	967	84
1920	2,666	2,283	383	1,825	841	86
1925	2,740	2,335	405	1,627	1,113	79
1930	3,471	2,887	584	1,894	1,577	71
1935	4,037	3,337	700	2,179	1,858	67

[1] Data from United States Census Reports.

farm land was in small operating units, with the majority of farm operators being white owners. An indication of this is given in table 2, in terms of the situation in 1938 in Jones County.

As shown in table 3, approximately 43 per cent of the farms were less than 50 acres in size, 1,304 farms being in this group, but these farms contained only about 15 per cent of the farm land in the area. Eighty-six per cent of the farms were less than 150 acres in size and constituted 58 per cent of the land area. Only 14 per cent of the farms were 150 acres and more in size, but this relatively small number of farms contained about 42 per cent of the total land in farms. Approximately 2 per cent of the farms were of more than 400 acres and contained about 15 per cent of the land in farms.

D. & P. L. was the most popular variety of cotton grown. Hastings Prolific was the most important variety of corn grown, while Tennessee Red Cob and Mosby Prolific were the next most important corn varieties. Triumph was the variety of potatoes grown for starch, while Porto Ricos were grown for home use and market.

Table 3. Proportion of Farms and Farm Land in Units of Various Sizes, for Jones County, Mississippi, 1938[1]

Size of farm (acres)	Number of farms	Proportion of all farms	Average acreage per farm	Proportion of total farm land	Size of farm (acres)	Number of farms	Proportion of all farms	Average acreage per farm	Proportion of total farm land
0- 9	48	1.6	8.4	.1	150-189	169	5.5	157.6	9.4
10- 29	365	12.0	19.3	2.5	190-209	69	2.3	198.4	4.9
30- 49	891	29.2	39.5	12.5	210-279	78	2.5	241.7	6.7
50- 69	339	11.1	63.7	7.7	280-399	53	1.7	325.8	6.1
70- 89	520	17.0	86.3	15.9	400-699	40	1.3	509.8	7.2
90-109	167	5.5	105.6	6.2	700 and over	15	.5	1,462.0	7.8
110-149	301	9.8	121.8	13.0	Totals	3,055	100.0		100.0

[1] Taken from 1938 AAA records from County Agent's Office, unpublished data compiled by C. L. Welch, from applications submitted 1938.

FARM ORGANIZATION, 1939

Land Use

The average size farm surveyed was 130 acres, of which 48 acres were in crops, 64 acres in woods, and 9 acres in tillable open pasture. Open pasture not tillable, idle cropland, farmstead, waste, and roads make up the remaining 8 acres (table 4).

The farms growing starch potatoes had a total of 123 acres per farm, of which 50 acres were in crops, while the farms which grew no starch potatoes had a total of 137 acres, with 46 acres in crops. Although the farms which grew starch potatoes were smaller than those that did not, they had more acres in crops per farm, a much greater percentage of the farm land in crops, and about one half as much idle land per farm.

Table 4. Land Use, 100 Farms, Jones County, Mississippi, 1939

Item	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms	
	Acres	Per cent	Acres	Per cent	Acres	Per cent
Total acres of crops	52.8	43.1	48.0	35.1	50.4	39.0
Acres double-cropped	2.7	2.2	1.6	1.2	2.1	1.8
Land in crops	50.1	40.9	46.4	33.9	48.3	37.2
Idle crop land	1.3	1.1	3.3	2.4	2.3	1.8
Open pasture tillable	9.6	7.8	8.5	6.2	9.0	6.9
Open pasture not tillable	3.6	2.9	3.7	2.7	3.6	2.8
Woods pastured	36.6	29.8	35.9	26.2	36.3	28.0
Woods not pastured	18.6	15.2	37.2	27.1	27.9	21.5
Farmstead, waste, roads, etc.	2.8	2.3	2.0	1.5	2.4	1.8
Total or average	122.6	100.0	137.0	100.0	129.8	100.0

The relatively large acreage in woodland is the source of fuel for the farm families, pulpwood for the Masonite plant, timber for lumber mills and box and furniture factories. A large proportion of the woodland on the farms comprises rough and eroded land, unsuited for cultivation. Permanent pastures could be improved by clearing of brush and seeding with a suitable pasture seed mixture. Low price of land is a factor favoring the use of land as pasture.

Capital Invested

The average total investment per farm studied was $3,930, or $81 per acre in crops. Of this total investment, 73 per cent was in land, buildings and improvements, 9 per cent in workstock, 7 per cent in livestock, 6 per cent in equipment, and 5 per cent in feed, seed, and supplies (table 5).

The two groups of farms had about the same average investment. The 50 farms growing starch potatoes had an average investment of $4,012, as compared to $3,847 on 50 farms not growing starch potatoes. The percentage of farm capital in operating capital is sometimes used as a measure of operating efficiency. The farms which grew starch potatoes had a higher percentage of their total capital investment in operating capital than did the group of comparable farms not growing starch potatoes. The investment per acre in land and buildings averaged $23 on the 100 farms and did not

Table 5. Distribution of Capital, 100 Farms, Jones County, Mississippi, 1939

Item	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms	
	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent
Land	1,741	43.3	1,679	43.7	1,710	43.5
Buildings	1,129	28.1	1,224	31.8	1,176	29.9
Workstock	348	8.7	352	9.2	350	8.9
Livestock	304	7.6	240	6.2	272	6.9
Feed, seed and supplies	231	5.8	160	4.2	198	5.1
Equipment (other than power equip.)	176	4.4	156	4.0	166	4.2
Power equipment	83	2.1	33	.9	58	1.5
Total	4,012	100.0	3,847	100.0	3,930	100.0
Investment in land and buildings per acre	24.09		20.82		22.54	

vary greatly, ranging from $21 on the farms not growing starch potatoes to $24 on the farms growing them.

Acres and Yields of Principal Crops

In terms of acreage, corn was the most important crop grown. Corn accounted for 50 per cent of the total crop acres, cotton 26 per cent, sweetpotatoes for starch 6 per cent, and all hay 11 per cent. Corn and cotton were grown on all farms (table 6).

There was an average of 50 acres of crops per farm, ranging from 53 acres on the farms growing starch potatoes to 48 acres on those farms which did not grow starch potatoes. Starch potatoes constituted 11 per cent of the total crop acres on the farms growing them. An average yield of 16 bushels of corn and 287 pounds of cotton were produced per acre on the farms studied, as compared to 13 bushels of corn and 301 pounds of cotton for the State.* The average yields per acre of other crops are as follows: hay 1.3 tons, sugar cane 196 gallons sirup, sweetpotatoes other than starch 97 bushels, sweetpotatoes for starch 166 bushels, and Irish potatoes 77 bushels. It is interesting to note that the yield of sweetpotatoes for starch production is very much higher than that of sweetpotatoes for other uses. This is due in part to the fact that a larger amount of fertilizer is used and more attention is given to starch potatoes; and in general the starch potato plants are set out earlier, since a greater per cent of farmers growing starch potatoes use hot beds.

The land devoted to cotton was about the same for both groups of farms studied. The average of 25 acres of corn per farm did not vary greatly on the two groups of farms. Commercial truck crops were grown on 25 farms, averaging 4 acres for farms growing them.

*U. S. Crops and Markets, December, 1939.

Figure 3.—**HARVESTING SWEETPOTATOES FOR THE LAUREL STARCH FACTORY.**

Table 6. Acres and Yields of Principal Crops, 100 Farms, Jones County, Mississippi, 1939

Item	50 farms growing starch potatoes				50 farms not growing starch potatoes				Total 100 farms			
	No. of farms growing	Av. acres per farm growing	Av. yield per acre harvested	% of total crop acres	No. of farms growing	Av. acres per farm growing	Av. yield per acre harvested	% of total crop acres	No. of farms growing	Av. acres per farm growing	Av. yield per acre harvested	% of total crop acres
Corn	50	23.9	16.3 bu.	45.4	50	26.0	15.5 bu.	54.3	100	25.0	15.9 bu.	49.6
Cotton	50	12.7	288 lbs.	24.1	50	13.4	287 lbs.	28.0	100	13.1	287 lbs.	26.0
Sweet potatoes for starch	50	5.7	166 bu.	10.8	—	—	—	—	50	5.7	166 bu.	5.6
Soybeans for hay	16	3.3	1.4 T.	2.0	21	4.6	1.4 T.	4.0	37	4.1	1.4 T.	3.0
Oats for hay	24	3.1	1.0 T.	2.9	19	3.6	1.2 T.	2.9	43	3.3	1.1 T.	2.9
Cowpeas for hay	24	3.0	1.3 T.	2.7	13	4.5	1.3 T.	2.4	37	3.5	1.3 T.	2.6
Commercial truck crops	20	4.3	—	3.2	5	2.0	—	.4	25	3.7	—	1.8
Native hay	10	3.6	.8 T.	1.4	11	2.5	1.2 T.	1.2	21	3.0	1.0 T.	1.3
Garden	50	.6	—	1.2	50	.5	—	1.1	100	.6	—	1.2
Cane for syrup	43	.8	231 gal.	1.3	39	.5	137 gal.	.8	82	.7	196 gal.	1.1
Sweet potatoes (other than starch)	19	.8	113 bu.	.6	43	.8	90 bu.	1.4	62	.8	97 bu.	1.0
Potatoes, Irish	34	1.0	81 bu.	1.3	34	.4	67 bu.	.5	68	.7	77 bu.	.9
Orchard	15	2.3	—	1.3	15	.9	—	.5	30	1.6	—	.9
Lespedeza	11	2.7	1.8 T.	1.1	4	2.8	1.2 T.	.5	15	2.7	1.6 T.	.8
All other	—	—	—	.7	—	—	—	2.0	—	—	—	1.3
Total or average	50	52.8	—	100.0	50	48.0	—	100.0	100	50.4	—	100.0

Crop Sales

Notwithstanding recent interest in starch sweetpotatoes, cotton is still the major cash crop in Jones County. Cotton and cottonseed represented 54 per cent of the total crop receipts, starch potatoes 19 per cent, corn 10 per cent, truck crops 8 per cent, and sugar cane 5 per cent on the 100 farms studied (table 7).

The average net crop sales on the farms studied was $551. The 50 farms growing starch potatoes had the largest net crop sales, averaging $729 per farm. The farms not growing starch potatoes averaged $372 net crop sales.

The starch potato farms averaged 42 per cent of their total crop receipts from cotton, as compared to 76 per cent on the farms which grew no starch potatoes; however, the value of the total sales of cotton and cottonseed for these two groups was about the same, averaging $390 for the farms growing starch potatoes and $404 for the farms not growing starch potatoes. Twenty-nine per cent of the total crop receipts came from starch potatoes on the farms that grew them.

Cotton and cottonseed were the major items used in payment of cropper labor, constituting 52 per cent of the total payments on the farms not growing starch potatoes and 44 per cent on the farms growing starch potatoes (table 8). The cost of cropper labor was $457 on the farms with croppers and no starch potatoes, as compared to $490 on the farms with croppers and starch potatoes.

The croppers worked an average of 20.2 months on the farms with no starch potatoes, and 17.6 months on the farms with starch potatoes. The cost per month of cropper labor was $23 on the farms with no starch potatoes, as compared to $28 on the farms with starch potatoes.

Table 7. Gross Crop Sales, 100 Farms, Jones County, Mississippi, 1939[1]

	50 farms growing starch potatoes			50 farms not growing starch potatoes			Total 100 farms		
Crops	No. of farms selling	Av. sales per farm selling	% total crop sales	No. of farms selling	Av. sales per farm selling	% total crop sales	No. of farms selling	Av. sales per farm selling	% total crop sales
Cotton and cottonseed	50	390	41.7	50	404	75.5	100	397	54.0
Sweetpotatoes for starch	49	278	29.1	—	—	—	49	278	18.5
Corn	19	169	6.9	17	226	14.3	36	196	9.6
Truck crops	20	240	10.2	5	205	3.8	25	233	7.9
Cane syrups	41	72	6.3	29	30	3.3	70	55	5.2
Potatoes, Irish	11	145	3.4	4	39	.6	15	117	2.4
Sweetpotatoes other than starch	7	44	.7	14	32	1.7	21	36	1.0
Orchard products	8	90	1.5	2	21	.2	10	76	1.0
All others	—	—	.2	—	—	.6	—	—	.4
Total or average	50	936	100.0	50	535	100.0	100	736	100.0
Average sales per farm for payment of cropper labor	—	207	—	—	163	—	—	185	—
Net crop sales per farm	—	729	—	—	372	—	—	551	—

[1] Includes sales for payment of cropper labor.

Table 8. Sales for Payment of Cropper Labor, 100 Farms, Jones County, Mississippi, 1939

Crops	50 farms growing starch potatoes			50 farms not growing starch potatoes			Total 100 farms		
	No. of farms paying	Av. payment per farm paying	% of total sales for payment of cropper labor	No. of farms paying	Av. payment per farm paying	% of total sales for payment of cropper labor	No. of farms paying	Av. payment per farm paying	% of total sales for payment of cropper labor
Cotton and Cottonseed	19	240	44.0	17	251	52.3	36	245	47.7
Corn	18	169	29.3	16	227	44.6	34	196	36.0
Starch potatoes	13	131	16.4	—	—	—	13	131	9.2
Sugarcane	3	133	3.9	6	30	2.2	9	64	3.1
Truck crops	1	500	4.8	—	—	—	1	500	2.7
Potatoes, Irish	1	165	1.6	—	—	—	1	165	.9
Peas (seed)	—	—	—	1	34	.4	1	34	.2
Sweetpotatoes other than starch	—	—	—	2	18	.4	2	18	.2
Peanuts	—	—	—	1	6	.1	1	6	*
Total sale for payment	19	545	100.0	17	479	100.0	36	514	100.0
Expenses paid by cropper	19	117	—	17	97	—	36	108	—
Net crop payment	19	428	—	17	382	—	36	406	—
Cropper AAA payment	19	62	—	17	75	—	36	69	—
Total cost of croppers' labor	19	490	—	17	457	—	36	475	—

*Less than 0.1 per cent.

Livestock and Livestock Products

A small number of livestock were kept on all farms. The chief source of farm power was supplied by mules. On the 100 farms surveyed there was an average of three head of workstock valued at $344, 3.5 milk cows valued at $118, one brood sow, 4.6 other hogs, and 50 chickens per farm (table 9).

Table 9. Number and Value of Livestock per Farm, 100 Farms, Jones County, Mississippi, 1939[1]

Kind of livestock	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms	
	Number per farm	Value per farm	Number per farm	Value per farm	Number per farm	Value per farm
Horses	.8	82	.4	53	.6	67
Mules	2.3	264	2.4	289	2.3	277
Colts	*	2	.2	10	.1	6
Milk cows	2.2	143	3.8	92	3.5	118
Heifers, 1 year.	1.1	19	1.5	30	1.3	25
Calves	1.9	15	2.4	19	2.1	17
Bulls	.1	5	.1	3	.1	4
Beef cattle	.8	12	.9	18	.9	15
Brood sows	.9	14	.8	14	.9	14
Other hogs	5.5	42	3.7	32	4.6	37
Pigs	1.9	5	2.4	8	2.2	6
Chickens	57.6	35	41.9	23	49.8	29
All other livestock	—	14	—	1	—	7
Total	—	652	—	592	—	622

[1] Average of beginning and ending inventory for number and value.

*Less than 0.1.

Table 10. Sale of Livestock, 100 Farms, Jones County, Mississippi, 1939

Kind of livestock	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms		
	No. of farms selling	Value of sales per farm selling	No. of farms selling	Value of sales per farm selling	No. of farms selling	Value of sales per farm selling	% of total sales
Horses	3	85	1	75	4	83	4.2
Mules	5	103	2	88	7	99	8.7
Colts	—	—	2	118	2	118	2.9
Total workstock							15.8
Milk cow	8	63	6	39	14	53	9.3
Heifers—1 yr.	7	37	6	64	13	49	8.0
Calves	19	36	21	17	40	26	13.2
Bulls	—	—	2	26	2	26	.6
Beef cattle	1	400	1	175	2	288	7.2
Total cattle							38.3
Brood sows	2	15	4	27	6	23	1.7
Other hogs	14	128	11	63	25	100	31.4
Pigs	10	13	7	35	17	22	4.6
Total hogs							37.7
Chickens	9	16	13	7	22	11	2.9
All others	—	—	—	—	—	—	5.3
Total or average	50	103	50	56	100	79	100.0

The sale of livestock was of minor importance on all the farms, amounting to only $79 per farm. Most of the livestock was kept for home use. On the farms which grew starch potatoes the sales from livestock amounted to $103, as compared to $56 on the farms not growing starch potatoes.

The sale of cattle and hogs accounted for the major portion of livestock receipts. Cattle represented 38 per cent of the total livestock sales; hogs 38 per cent; workstock 16 per cent; and chickens 3 per cent. Calves were sold on more farms than other classes of livestock (table 10).

Table 11. Sale of Livestock Products, 100 Farms, Jones County, Mississippi, 1939

Kind of livestock products	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms		
	No. of farms selling	Value of sales per farm selling	No. of farms selling	Value of sales per farm selling	No. of farms selling	Value of sales per farm selling	% of total sales
Milk	7	74	4	57	11	67	11.8
Butter	8	29	5	44	13	35	7.1
Eggs	41	70	38	21	79	47	58.4
Fryers	23	18	18	15	41	17	10.9
Pork	8	80	1	48	9	76	10.8
Lard	—	—	1	12	1	12	.2
Beef	1	16	—	—	1	16	.2
Other	—	—	—	—	—	—	.6
Total or average	50	95	50	32	100	63	100.0

On the farms growing starch potatoes, the sale of livestock products amounted to $95, as compared to $32 on the farms which did not grow them, and averaged $63 on all farms (table 11). Eggs were the most important product sold. They were sold on 79 farms and represented 58 per cent of the livestock products sold.

Miscellaneous Receipts

The AAA payments constituted approximately 100 per cent of the $118 miscellaneous receipts per farm. Receipts from other sources, such as road work, factory work, and truck driving were not included in the miscellaneous receipts. Incomes from farming in recent years in Jones County have not been large enough to greatly encourage either the development of new farms or an extensive improvement of those already in operation. The opportunity for doing outside work in connection with roads, the Masonite plant, and saw mills is diverting the energy of some people from farming, but many people must depend upon a greater efficiency in the operation of their farms. Thirty-two per cent of the farmers had an average income of $389 from outside employment which was not included in the farm receipts in this analysis. The two most common types of outside employment were road work and truck driving.

Total Farm Receipts

The average total farm receipts for the 100 farms studied was $1,081, ranging from $89 on a one-horse farm with no starch potatoes to $8,495 on a highly diversified farm with $1,200 cash receipts from starch potatoes. Eleven farms had less than $250 of farm receipts, 33 farms had less than

Table 12. Average Farm Receipts, 100 Farms, Jones County, Mississippi, 1939

Item	50 farms growing starch potatoes		50 farms not growing starch potatoes		Total 100 farms	
	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent
Cotton and cottonseed	390	28.7	404	50.4	397	36.7
Sweetpotatoes for starch	272	20.0	—	—	136	12.6
Corn	65	4.8	77	9.6	71	6.6
Truck crops	96	7.1	21	2.6	58	5.4
Cane syrups	59	4.3	17	2.1	38	3.5
Potatoes, Irish	32	2.4	3	.4	18	1.7
Sweetpotatoes other than starch	6	.4	9	1.2	8	.7
Orchard products	14	1.0	1	.1	8	.7
Other crops	2	.1	3	.4	2	.2
TOTAL CROPS	936	68.8	535	66.8	736	68.1
Poultry	77	5.7	23	2.9	50	4.6
Cattle	53	3.9	33	4.1	43	4.0
Hogs	52	3.8	22	2.7	37	3.4
Workstock	15	1.1	10	1.3	12	1.1
TOTAL LIVESTOCK[1]	197	14.5	88	11.0	142	13.1
Miscellaneous	118	8.7	117	14.6	118	10.9
Increase in inventory	109	8.0	61	7.6	85	7.9
Total	1,360	100.0	801	100.0	1,081	100.0

[1] Includes livestock products.

$500, 50 farms had less than $750, and 63 farms had less than $1,000 of farm receipts. Six farms had farm receipts of over $2,500.

Of this $1,081 average farm receipts, $736, or 68 per cent, came from crops, $142, or 13 per cent came from livestock and livestock products, $118, or 11 per cent, came from miscellaneous sources, and $85, or 8 per cent, was due to increases in inventories (table 12).

Current Farm Expenses

The current or cash farm expenses amounted to $608 per farm on the 100 farms studied. Cropper labor and fertilizer were the most important items of expense. Cropper labor accounted for 28 per cent of the current farm expenses, fertilizer 26 per cent, hired labor 15 per cent, feed purchased and taxes 6 per cent each, and seed and ginning 4 per cent each. Fertilizer, taxes, and ginning were the only cash expenses occurring on all farms (table 13). Current expenses on starch potato farms averaged $717, of which fertilizer and cropper labor represented 26 per cent each, hired labor 16 per cent, feed purchased 7 per cent, taxes 5 per cent and seed and starch potato hauling 4 per cent each. The average current expense on the

Table 13. Distribution of Current Expenses, 100 Farms, Jones County, Mississippi, 1939

	50 farms growing starch potatoes			50 farms not growing starch potatoes			Total 100 farms		
Item	No. of farms incurring	Expense per farm incurring	% of total expense	No. of farms incurring	Expense per farm incurring	% of total expense	No. of farms incurring	Expense per farm incurring	% of total expense
Cropper labor	19	490	26.0	17	457	31.2	36	475	28.1
Fertilizer	50	186	26.0	50	133	26.7	100	159	26.2
Hired labor*	43	134	16.1	34	103	14.1	77	120	15.3
Feed purchased	42	56	6.6	41	29	4.8	83	43	5.9
Taxes	50	32	4.5	50	36	7.3	100	34	5.6
Seed	48	28	3.8	48	20	3.8	96	24	3.8
Ginning	50	22	3.1	50	23	4.6	100	23	3.7
Potato hauling	39	37	4.0	2	4	**	41	35	2.4
Truck expense (farm)	16	50	2.2	6	58	1.4	22	52	1.9
Insurance (bldgs.)	17	28	1.3	20	18	1.4	40	21	1.4
Syrup pails	34	15	1.4	27	6	.7	61	11	1.1
Auto expense (farm)	6	66	1.1	3	59	.7	9	64	.9
Blacksmithing	28	7	.5	26	11	1.2	54	9	.8
Repair buildings	8	37	.8	4	17	.3	12	30	.6
Interest	23	9	.6	11	14	.6	34	10	.6
Rent	7	45	.9	—	—	—	7	45	.5
Repair fences	5	29	.4	7	16	.4	12	21	.4
Tractor expense	1	84	.2	1	25	.1	2	55	.2
Veterinary fees and medicine	10	3	.1	9	12	.4	19	7	.2
Breeding fees	5	8	.1	1	1	**	6	7	.1
Repair drains and terraces	2	13	.1	2	5	**	4	9	.1
Others	—	—	.2	—	—	.3	—	—	.2
Total or average	50	717	100.0	50	498	100.0	100	608	100.0

*Includes board

**Less than 0.1 per cent.

farms not growing starch potatoes was $498 of which cropper labor constituted 31 per cent, fertilizer 27 per cent, hired labor 14 per cent, taxes 7 per cent, feed purchased and cotton ginning 5 per cent each.

The largest amount of fertilizer was used on the potato farms, which averaged $186 per farm, as compared to $133 on the farms not growing them. The starch potato farms spent $490 for cropper labor per farm, as compared to $457 on the non-starch potato farms which had croppers. Hired labor was an important item of expense on all farms.

Feed purchased ranged from $56 on the starch potato farms to $29 on those not growing them. Potato hauling was an important item of expense on the farms which grew starch potatoes, averaging $35 per farm incurring.

In addition to the current expenses discussed above, charges for unpaid family labor, power and other equipment purchased, livestock purchased, real estate improvements and decreases in inventories are included in the total farm expenses. Of the $765 total farm expenses, $608 or 80 per cent was current expense. Unpaid family labor, livestock purchased, real estate improvements, power and other equipment purchased, and decreases in inventories make up the remaining $157 or 20 per cent (table 14).

Products Furnished the Family by the Farm

The average value of products furnished the family by the farm was $355 for the 100 farms studied. Of this total, food amounted to $251 or 71 per cent, rental value of the house $71 or 20 per cent, and wood $33 or 9 per cent. The value of the products furnished the family by the farm was about the same for each of the two groups studied.

Milk was the most valuable product furnished the family by the farm. Milk was produced on 99 farms and was valued at $82 per family using, and $20 per capita using. House rent, which was charged on all farms, averaged $71 per farm or $17 per capita. The home garden, which was found on all farms, furnished the family with vegetables valued at $57 per farm and $14 per capita. Pork for home use was produced on 90 farms, averaging $48 per family using, and $12 per capita using. The consumption of eggs on the 97 farms using was 127 dozen per family, valued at $21 or 30 dozen per capita, valued at $5. The value of livestock products furnished the family by the farm was $37 per capita. Orchards were found on about one third of the farms studied. They were valued at $18 per farm having, or $4 per capita.

Since the value of the products furnished the family by the farm averaged $355 per farm, or $85 per capita, it is an important factor to be considered in analyzing the farm business. It is interesting to note that the average value of the products furnished the family by the farm actually exceeded the farm income by $39 on all farms surveyed. Since this is a county of small farms, one would expect the value of the products furnished the family by the farm to be a large part of the income.

Profits

There are several measures of farm profits, such as farm income, labor income, labor earnings and per cent returned on capital. Labor income is the most common measure of farm profits used and may be termed the standard measure. Labor income is the amount left at the end of the year for the farmer's labor and management after all expenses, and 4 per cent interest on the average investment have been deducted. In addition to this, but not included in his labor income, the operator receives certain farm privileges, such as a house in which to live, food, and wood for fuel. The method of calculating the other measures is included in the definition of terms.

The average labor income on all farms was $159. The starch potato farms had a labor income of $295, as compared to $23 on the farms which did not grow starch potatoes (table 14).

The value of products furnished the family by the farm was about the same for each of the groups studied. Labor earning averaged $651 on the farms growing starch potatoes and $376 on those not growing them. The average per cent return to capital on the 100 farms was 4.3 per cent, ranging from 7.4 per cent on the starch potato farms to 1.1 on the non starch potato farms.

The labor income on the farms studied varied from —$550 on a farm with only cotton as a cash crop to $1,983 on a large diversified farm with starch potatoes. The majority of the farms fell within the range of —$249 to $249 with 72 per cent of the farms falling within this group. Thirty-two of the farms had a negative labor income. Only three farms had a labor income of more than $1,000.

It is interesting to note that the farms growing starch potatoes had much higher receipts, farm income, labor income, labor earnings, and per cent

Table 14. Summary of Farm Business, 100 Farms, Jones County, Mississippi, 1939

Item	50 farms growing starch potatoes	50 farms not growing starch potatoes	Total 100 farms
Average capital	4,012	3,847	3,930
Farm receipts:			
Crop	936	535	736
Livestock sold	102	56	79
Livestock products sold	95	32	63
Miscellaneous	118	117	118
Increase in inventory	109	61	85
Total receipts	1,360	801	1,081
Farm expenses:			
Current expenses	717	498	608
Unpaid family labor	38	32	35
Livestock purchased	62	28	45
Real estate improvements	11	28	20
Power equipment purchased	14	2	8
Other equipment purchased	32	10	21
Decrease in inventory	31	26	28
Total expense	905	624	765
Farm income	455	177	316
Interest on investment @ 4%	160	154	157
Labor income	295	23	159
Value of family living	356	353	355
Labor earnings	651	376	514
Return to capital	296	42	169
Average return on investment	7.4%	1.1%	4.3%

returned to capital, than did the group of comparable farms that did not grow starch potatoes. However, the farms that grew starch potatoes were more diversified than the group of comparable farms that did not grow starch potatoes, as shown by increased receipts from livestock and livestock products, and all crops other than cotton. It appears that in general the more progressive farmers grew starch potatoes and it seems likely that as a group they would have had a higher income than the other group, even though they had not grown starch potatoes.

FACTORS AFFECTING PROFITS

Size of Business

Due to the fact that some farmers are more successful than others, it is interesting and important to note the reasons why this is true. In farm management studies, the size of farm business may be measured by several methods, such as days of productive work, acres in crops, capital invested, man equivalent, productive animal units and number of workstock. Perhaps, due to the fact that all enterprises are taken into account, the best measure of size of farm business is man days of productive work.

There was an average of 388 man days of productive work per farm on the 100 farms surveyed. Thirty-seven farms had less than 250 man days of productive work, 33 farms had from 250 to 399, and 30 farms had more than 400 (table 15). There was a direct relationship between size of business as measured by man days of productive work and labor income. Farms with less than 250 man days of productive work had a labor income of $36, compared with $110 on farms having from 250 to 399, and $365 on farms with 400 or more. Other measures of profits, such as farm receipts, farm income, and labor earnings, increased consistently as the size of the business increased. As the man days of productive work was increased, the other measures of size increased in about the same proportion. As the average man days of productive work increased from 181 to 719, the acres in crops per farm increased from 23 to 90, and at the same time man equivalent increased from 1.3 to 3.3. The number of workstock increased from 1.6 to 5, and productive animal units from 5 to 14.

Labor efficiency increased consistently as the size of the farm increased (tables 15 and 16). The days of productive work per man increased from 146 on the farms with less than 250 man days of productive work to 221 on the farms with 400 or more. Also, the days of productive work per horse increased as the size of farm business increased. The crop index increased as the size of the business increased, ranging from 92 on the small farms to 107 on the large farms. The price index remained almost constant.

When the size of business is measured by acres in crops, it is found that the same general conditions existed. That is, as the acres in crops increased, the farm receipts, farm income, labor income, and labor earnings increased. Labor income increased from $51 on farms with less than 30 acres in crops to $122 on farms having 30 to 59 acres in crops, and $412 on the farms that had more than 60 acres in crops. Labor efficiency and capital efficiency increased as the acres in crops increased. The crop index increased as the acres in crops increased, but the price index did not (table 17).

Table 15. Relation of Man Days of Productive Work to Profit and Other measures of Size, Jones County, Mississippi, 1939

Man days of productive work	Number of farms	Averages per farm										
		Man days of productive work	Man equivalent	Horse days of productive work	No. of work-stock	Productive animal units	Acres in crops	Total receipts	Total expenses	Farm income	Labor income	Labor earnings
Less than 250	37	181	1.3	85	1.6	5	23	421	300	121	36	352
250-399	33	318	1.8	154	2.4	7	40	818	581	237	110	468
400 or more	30	719	3.3	338	5.0	14	90	2,187	1,542	645	365	763
Total	100	388	2.1	184	2.9	8	48	1,081	765	316	159	514

Table 16. Relation of Man Days of Productive Work to Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Man days of productive work	No. of farms	Averages per farm								
		Man days of productive work	Crop index	Price index	Days of productive work per man	Days of productive work per horse	Years for receipts to equal farm capital	% man days of productive work on starch potatoes	% man days of productive work on cotton	Average capital
Less than 250	37	181	92	100	146	57	5.0	5	38	2,110
250-399	33	318	102	101	185	70	3.9	10	36	3,150
400 or more	30	719	107	100	221	74	3.2	10	39	7,010
Total	100	388	100	100	188	63	3.6	9	37	3,930

Table 17. Relation of Size of Business, as Measured by Acres in Crops, to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Acres in crops	No. of farms	Averages per farm													
		Acres in crops	Man days of productive work	Total receipts	Total expenses	Farm income	Labor income	Labor earnings	Average capital	Crop index	Price index	Days of productive work per man	Years for receipts to equal farm capital	% man days of productive work on starch potatoes	% man days of productive work on cotton
Less than 30	34	22	178	446	314	132	51	368	2,010	94	100	142	4.5	5	37
30-59 - ----	45	42	344	872	612	260	122	477	3,430	100	101	192	3.9	10	36
60 or more--	21	107	820	2,557	1,822	735	412	829	8,080	110	99	222	3.2	8	42
Total - ----	100	48	388	1,081	765	316	159	514	3,930	100	100	188	3.6	9	37

Table 18. Relation of Size of Business, as Measured by Average Capital to Profits, Other Measures of Size, and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Average capital	No. of farms	Averages per farm														
		Average capital	Years for receipts to equal farm capital	Man days of productive work	Acres in crops	Crop index	price index	Total receipts	Total expense	Farm income	Labor income	Labor earnings	Value of operator labor	Days of productive work per man	% man days of productive work on starch potatoes	% man days of productive work on cotton
Less than 2,400 - ------	35	1,660	3.4	215	25	91	101	490	334	156	89	391	116	161	7	36
2,400 to 3,999 ---	32	3,150	4.1	305	38	99	100	760	518	242	116	466	130	172	9	37
4,000 or more ---	33	7,060	3.5	651	83	111	100	2,018	1,461	557	275	689	198	212	8	40
Total - -------	100	3,930	3.6	388	48	100	100	1,081	765	316	159	514	148	188	9	37

When the size of business is measured by the amount of capital invested, it was found that the same relationship exists as when the size of business is measured by man days of productive work, and acres in crops. Capital efficiency was highest on the farms with the smallest capital investment, and lowest on the middle group. It would require 3.4 years for the receipts to equal the farm capital on the farms with less than $2,400 capital invested, 4.1 years on the farms with $2,400 to $3,000 invested, and 3.5 years on the farms with $4,000 or more invested (table 18).

Labor Efficiency

Labor efficiency is one of the chief factors to be considered in accounting for high incomes on some farms and low incomes on others. Perhaps the best measure for labor efficiency is days of productive work per man, which is found by dividing the number of days of productive work on the farm by the man equivalent. If weighted by crop index, it is very good. The man equivalent may be found by dividing the total months of work on the farm by 12.

Thirty-eight of the farms had labor efficiency of less than 160 days of productive work per man, while 30 averaged from 160 to 199, and 32 farms averaged over 200 days of productive work per man. Labor income increased as the days of productive work per man increased. Farms with less than 160 days of productive work per man had a labor income of $1, compared to $120 on farms with 160 to 199, and $383 on farms with 200 or more. The size of the farm, as measured by man days of productive work, acres in crops, and average capital, increased as the days of productive work per man increased. For this reason, all of the increase in labor income as shown in table 19, cannot be credited to the increase in labor efficiency. Capital efficiency increased as days of productive work per man increased. Labor efficiency did not have a direct effect upon crop index and price index. As labor efficiency increased, the per cent of man days of productive work on starch potatoes increased from 5 per cent on farms with less than 160 days of productive work per man to 12 per cent on farms with 200 or more days of productive work per man.

Production Efficiency

Production efficiency of crops was measured by a factor known as crop index. The yields of the seven major crops—cotton, corn, hay, Irish potatoes, sweetpotatoes for starch, sweetpotatoes for other uses, and cane for syrup—were expressed as a percentage of the average yield for the area to obtain the crop index.

Labor income increased as crop indices increased. Farms with a crop index of less than 85 had a labor income of $10, compared to $102 on farms with crop indices of 85 to 109, and $373 on farms with crop indices of 110 or more (table 20). Thirty-five of the farms surveyed had a crop index of less than 85; 32 had crop indices ranging from 85 to 109; and 33 had crop indices of 110 or more. The size of business was a definite factor affecting crop index. Acres in crops and man days of productive work increased consistently with increases in the crop index. Labor efficiency and

Table 19. Relation of Labor Efficiency to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Days of productive work per man	Number of farms	Averages per farm												
		Days of productive work per man	Man days of production work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Average capital	Crop index	Price index	Years for receipts to equal farm capital	% man days of productive work on cotton	% man days of productive work on starch potatoes
Less than 160	38	130	235	31	560	450	1	333	2,710	94	101	4.8	37	5
160-199	30	179	333	42	860	599	120	485	3,500	104	99	4.1	41	7
200 or more	32	244	620	76	1,908	1,294	383	755	5,760	103	101	3.0	34	12
Total	100	188	388	48	1,081	765	159	514	3,930	100	100	3.6	37	9

Table 20. Relation of Crop Index to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939

Crop index	Number of farms	Averages per farm												
		Crop index	Price index	Man days of productive work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Value of operator's labor	Days of productive work per man	Years for receipts to equal farm capital	% man days of productive work on starch potatoes	% man days of productive work on cotton
Less than 85	35	72	100	270	35	551	433	10	329	122	169	4.9	5	37
85-109	32	99	100	385	49	900	628	102	463	150	191	4.7	8	40
110 or more	33	131	101	515	61	1,818	1,250	373	759	172	200	2.7	11	36
Total	100	100	100	388	48	1,081	765	159	514	148	188	3.6	9	37

capital efficiency increased as crop indices increased. The per cent of man days of productive work on starch potatoes increased from 5 per cent on farms with crop indices of less than 85 to 11 per cent on farms with crop indices of 110 or more.

Marketing Efficiency

Marketing or price efficiency was measured by a factor known as price index. Price index is the ratio of the prices received by each farmer to the average price received by all farmers in the survey. The prices received for the eight major cash enterprises—cotton, corn, sweetpotatoes for starch, sweetpotatoes for other uses, Irish potatoes, cane for syrup, and eggs—were expressed as the percentage of the average price for the area to obtain the price index for each farm. This index is an average of the prices of these commodities weighted by the value of the products sold. The price index reflects to a certain extent the farmer's marketing ability, and also the quality of products sold.

Thirty-six farms had price indices of less than 99; 33 had price indices of 99 to 101; and 31 had price indices of 102 or more (table 21). There was no consistent relation between price index and labor income in Jones County, 1939. The farms with the highest price indices had the lowest labor income. They were the smallest in size and had the lowest labor and capital efficiency, which probably explains the low income. When we consider the other two groups of farms, which were approximately the same size as measured by acres of crops and man days of productive work, we find that the price index had considerable effect on labor income. Farms with price indices of less than 99 had a labor income of $111, as compared to $258 on those having price indices of 99 to 101.

Capital Efficiency

Capital efficiency was measured by a factor called capital turn-over which is the number of years required for farm receipts to equal the farm capital. It may be obtained by dividing the farm receipts into the farm capital. As the number of years required for receipts to equal farm capital increased, the labor income decreased (table 22). The farms with the greatest capital efficiency had a labor income of $248 as compared to minus $48 on the farms with the poorest capital efficiency. Farms with the greatest capital efficiency were the largest in size, and had the highest labor efficiency and crop yields, whereas the farms with the poorest capital efficiency were the smallest in size, and had the lowest labor efficiency and crop yields.

During the year studied, capital efficiency seemed to be one of the most important factors in determining farm incomes, since there was a wider spread in income between the farms with the highest capital efficiency, and the farms with the poorest capital efficiency than there was between the high and low group of any other factors.

Table 21. Relation of Price Index to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939

Price index	Number of farms	Average per farm											
		Price index	Crop index	Man days of productive work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Days of productive work per man	Years for receipts to equal farm capital	% man days of productive work on starch potatoes	% man days of productive work on cotton
Less than 99	36	95	99	436	55	1,114	829	111	481	195	3.9	6	41
99-101	33	100	99	414	51	1,282	869	258	598	187	3.0	9	37
102 or more	31	107	102	303	38	829	581	109	462	180	4.2	8	34
Total	100	100	100	388	48	1,081	765	159	514	188	3.6	9	37

Table 22.—Relation of Capital Efficiency (Years for Receipts to Equal Farm Capital) to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Years for receipts to equal farm capital	Number of farms	Average per farm													
		Years for receipts to equal farm capital	Man days of productive work	Acres in crops	Days of productive work per man	% man days of productive work on cotton	% man days of productive work on starch potatoes	Total receipts	Total expense	Farm income	Labor income	Labor earnings	Average capital	Crop index	Price index
Less than 3.4	32	2.2	536	62	195	34	12	1,788	1,200	588	428	764	3,980	113	101
3.4 - 4.9	30	4.0	350	46	184	39	8	961	671	290	133	501	3,880	103	99
5.0 or more	38	6.7	293	39	167	39	4	581	473	108	—48	312	3,900	86	101
Total	100	3.6	388	48	188	37	9	1,081	765	316	159	514	3,930	100	100

Balance of Farm Business

Balance deals with the number and adjustment of enterprises on the farm. The more successful farmers are constantly striving to set up a system of farming which will enable them to use their land, labor, and capital in such a way as to insure the highest possible profits. The proper balance of farm enterprises varies greatly on individual farms, and for this reason, the conclusions drawn on the farms studied could not be applied to any one farm, but as a system of farming for the group as a whole.

There was an inverse relationship between the per cent of man days of productive work on cotton and labor income. That is, as the per cent of man days of productive work on cotton increased the labor income decreased (table 23). Farms with less than 34 per cent of man days of productive work on cotton had a labor income of $303; farms with 34 to 39 per cent of their man days of productive work on cotton had a labor income of $121, and the farms with 40 or more per cent of man days of productive work on cotton had a labor income of $63. In addition to having the highest labor income, the farms which had the smallest per cent of man days of productive work on cotton used labor more efficiently, sold crops for higher price, and had higher crop yields than did the farms which had a higher per cent of man days of productive work on cotton. The per cent of man days of productive work on starch potatoes decreased as the per cent of man days of productive work on cotton increased.

When balance is measured by the per cent of man days of productive work on starch potatoes, it was found that the farms which grew no starch potatoes had much the lowest labor income (table 24). The group of farms which averaged 10 per cent of their man days of productive work on starch potatoes had a slightly higher labor income than did the group of farms which averaged 21 per cent of their man days of productive work on starch potatoes; however, the former group used labor more efficiently, and were larger in size as measured by acres in crops and man days of productive work.

As the per cent of man days of productive work on crops increased and as the per cent of man days of productive work on livestock decreased, the labor income increased. The size of business, labor efficiency, and per cent man days of productive work on starch potatoes increased as the per cent of man days of productive work on crops increased (table 25).

The foregoing discussion indicates that the farms which spent less time on cotton and livestock and more time on starch potatoes and other crops were able to use their labor and other factors of production more efficiently and were, therefore, able to return more profits per farm.

Comparisons of Farms with High and Low Profits

The 25 most profitable farms and the 25 least profitable farms were compared to see what outstanding characteristics each group possessed (table 26).

The 25 most profitable farms had an average labor income of $608 as compared to —$139 on the 25 least profitable farms. The most profitable farms used their labor far more efficiently, having worked an average of

Table 23. Relation of Per Cent of Total Man Days of Productive Work on Cotton to Profit and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Per cent man days of productive work on cotton	Number of farms	Average per farm											
		% man days of productive work on cotton	% man days of productive work on starch potatoes	% man days of productive work on livestock	Man days of productive work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Crop index	Price index	Days of productive work per man
Less than 34	32	27	14	10	488	55	1,523	1,053	303	665	103	102	193
34 - 39	33	37	7	11	315	41	862	602	121	389	92	95	167
40 or more	35	48	2	9	386	49	883	655	63	413	100	98	184
Total	100	37	9	9	388	48	1,081	765	159	514	100	100	188

Table. 24. Relation of Per Cent of Total Man Days of Productive Work on Starch Potato to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Per cent man days productive work on starch potatoes	Number of farms	Averages per farm											
		% man days of productive work on starch potatoes	% man days of productive work on cotton	% man days of productive work on livestock	Man days of productive work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Crop index	Price index	Days of productive work per man
- 0	50	—	42	11	339	47	801	625	23	376	97	100	164
1 - 14	25	10	35	9	461	55	1481	1002	309	651	100	100	212
15 or more	25	21	31	9	411	46	1240	808	281	651	106	100	186
Total	100	9	37	9	388	48	1081	765	159	514	100	100	188

Table 25. Relation of Per Cent of Total Man Days of Productive Work on Crops to Profits and Other Factors Affecting Profits, Jones County, Mississippi, 1939.

Per cent man days of productive work on crops	Number of farms	Averages per farm												
		%man days of productive work on crops	% man days of productive work on cotton	% man days of productive work on starch potatoes	% man days of productive work on livestock	Man days of productive work	Acres in crops	Total receipts	Total expenses	Labor income	Labor earnings	Crop index	Price index	Days of productive work per man
Less than 89	34	85	36	6	15	238	30	598	446	32	394	97	101	166
89 - 91	33	90	40	7	10	351	44	1,041	737	153	494	99	99	175
92 or more	33	94	37	10	6	578	72	1,619	1,120	296	535	104	101	203
Total	100	91	37	9	9	388	48	1,081	765	159	514	100	100	188

Table 26. Comparison of Certain Factors on the 25 Most Profitable Farms and the 25 Least Profitable Farms With Average For All Farms, Jones County, Mississippi, 1939.

Factors	25 most profitable farms	25 least profitable farms	Average 100 farms
Man days of productive work	671	279	388
Acres in crops	79	38	48
Average capital	5,420	3,630	3,930
Total receipts	2,267	508	1,081
Total expenses	1,442	502	765
Farm income	825	6	316
Labor income	608	—139	159
Labor earnings	987	224	514
Crop index	120	81	100
Price index	101	99	100
Days of productive work per man	221	157	188
Years for receipts to equal farm capital	2.4	7.1	3.6
Per cent man days of productive work on cotton	33	41	37
Per cent man days of productive work on starch potatoes	13	3	9
Per cent man days of productive work on livestock	7	12	9

64 days more per man, than the least profitable farms. The size of business as measured by acres in crops and man days of productive work was twice as large on the most profitable farms as on the least profitable farms.

The 25 most profitable farms spent 33 per cent of their man days of productive work on cotton, 13 per cent on starch potatoes, and 7 per cent on livestock; whereas the 25 least profitable farms spent 41 per cent of their man days of productive work on cotton, 3 per cent on starch potatoes, and 12 per cent on livestock. The crop index on the most profitable farms was 20 per cent above average, while it was 19 per cent below average on the least profitable farms. The price index showed only a 2 per cent increase from the poorest farms to the best paying farms. The most profitable farms used their capital far more efficiently than did the least profitable farms. From the foregoing discussions, it is seen that the most profitable farms were largest in size, had higher crop yields, received higher prices, and used labor and capital more efficiently. The most profitable farms found it necessary to spend a smaller per cent of their time on cotton and livestock, and a larger per cent of their time on starch potatoes and other crops than did the least profitable farms.

COST OF PRODUCTION
COTTON AND STARCH POTATOES

Usual Cultural Practices

The first operation in preparation for a cotton crop is the cutting of stalks in December or January. The common practice is to "middle bust" the land in March and let it stay in this condition until fertilizer is applied. The fertilizer is usually put out and covered with two furrows, followed by a "middle buster" around April 1. Harrowing and planting vary greatly with the season and, to a less extent, with soil type, and takes place April

1 until May 15. The first cultivation is done around May 1, and consists of scratching with a side harrow. This operation is usually repeated just before "chopping."

Hoeing and chopping to a stand follows as soon as possible. The aftertillage depends on the conditions, but as a rule only shallow-working implements are used. Small heel sweeps and shovels are used to run around the cotton, increasing the size of each as the operation is repeated. On an average, cotton is "run around" and the "middles run out" four or five times. Cultivation ends the latter part of June or early July. Picking begins about the middle of August and continues as long as necessary, but is usually over by the first of October.

The majority of farmers in Jones County who produce starch potatoes grow their own plants. The first operation in the production of sweetpotatoes is the construction and seeding of hotbeds or coldframes which is done around March 1. Seed are usually bedded about one month before the plants are desired. When planting potatoes after cotton or corn, it is necessary to cut the stalks. Land preparation, one of the essentials of success, takes place in March and April. Either a turning plow, "middle buster" or both are used in breaking the land. The general rule is to "middle bust" the land, put out fertilizer, list with two furrows, and follow with a "middle buster." Due to the fact that potato plants are transplanted at intervals of one week or more, it is necessary to rebreak the soil for late planting. The beds are harrowed or "boarded" before the plants are set out and when possible they are set out immediately after or before a rain. The first cultivation, ten days after planting, is done with a side harrow. After hoeing, the common practice is to run around the potatoes and burst out the middles two or three times in each cultivation. The soil is worked from the middles to the drill so that a high ridge may be obtained. Cultivation ceases as soon as the vines interfere. The majority of the potatoes are harvested in October and November; however, some are harvested in September and December, and in extreme cases August and January.

Labor Requirements

In general, farmers are more concerned about getting a satisfactory return for their time than for their capital. A comparative study was made relative to the requirements of horse and man labor per acre of cotton and starch potatoes. It was found that starch potatoes required a few more man hours per acre than did cotton, starch potatoes averaging 123 man hours and cotton 108 man hours (table 27).

Transplanting and harvesting are the peak loads of man labor in the production of starch potatoes. Cultivation of starch potatoes required less time than cotton; however, harvesting required about the same. More horse labor was used to produce an acre of starch potatoes than was required for cotton, in which harvesting made up the greatest difference. An average of 58 horse hours was necessary to produce an acre of starch potatoes, as compared to 44 hours to produce an acre of cotton.

Table 27. Man and Horse Labor Per Acre, by Operations for Cotton and Starch Potatoes, Jones County, Mississippi, 1939

Item	Crops	Seeding and care of beds	Land Preparation	Transplanting	Cultivate and hoe	Total prior to harvest	Harvest	Total
	Starch potatoes	9	14	29	21	73	50	123
Man hours	Cotton	—	13[1]	—	40	53	55	108
	Starch potatoes	—	22	—	10	32	26	58
Horse hours	Cotton	—	17[1]	—	20	37	7	44

[1]Includes planting.

Costs and Returns

In studying the average inputs, costs and returns per acre of cotton, it was found that the cost of producing an acre of cotton was $24.57. Man labor ranked first in importance, consisting of 108 hours or 44 per cent of the total cost, and fertilizer next with an average of 344 pounds per acre, constituting 19 per cent of the total cost. Other items of cost are: Rental value of land 14.9 per cent, horse labor 8.9 per cent, and ginning 7 per cent (table 28).

The average value of cotton and cottonseed per acre was $30.37; the net return was $5.80 per acre.

Although the amounts of inputs varied from farm to farm, the average of the farms surveyed shows that an acre of starch potatoes required 123 man hours, 58 horse hours, 507 pounds of fertilizer, and 12.5 bushels of seed potatoes (table 29).

The average cost of producing an acre of starch potatoes was $41.88, of which man labor was the most important item of expense. Man labor represented 29 per cent of the total cost of production, fertilizer 18 per cent, hauling 16 per cent, and seed 15 per cent.

Table 28. Cost and Returns Per Acre of Cotton, Jones County, Mississippi, 1939.

Items	Average amount per farm	Cost	Per cent of total
Man labor, hours	108	$ 10.80	44.0
Fertilizer, pounds	344	4.69	19.1
Rental value of land		3.65	14.9
Horse labor, hours	44	2.20	8.9
Ginning		1.72	7.0
Seed, bushels	1	.81	3.3
Equipment expense[1]		.35	1.4
Truck and auto expense		.35	1.4
Total		$24.57	100.0
Number of farms growing	100		
Total acres of cotton	1,308		
Yield per acre, lbs. of lint	287		
Value of cotton and cottonseed per acre	$30.37		
Cost of cotton per acre	$24.57		
Net returns per acre	$ 5.80		

[1]Includes depreciation of machinery and cost of blacksmithing.

Table 29. Costs and Return Per Acre of Starch Potatoes, Jones County, Mississippi, 1939.

Items	Average amount per farm	Costs	Per cent of total
Man labor, hours	123	$ 12.30	29.4
Fertilizer, pounds	507	7.37	17.6
Hauling		6.62	15.8
Seed, bushels	12.5	6.25	14.9
Rental value of land		3.65	8.7
Horse labor, hours	58	2.90	6.9
Cost of bed[1]		1.09	2.6
Sacks[2]	23	.62	1.5
Equipment expense[4]		.46	1.1
Truck and auto expense[3]		.40	1.0
Spray material		.13	.3
Inspection fee		.09	.2
Total		$41.88	100.0
Number of farms growing	56		
Total acres of starch potatoes	285		
Yield per acre, bushels	166		
Value of potatoes per acre	$49.80		
Cost of potatoes per acre	$41.88		
Net returns per acre	$ 7.92		
Price received per bushel	$ 0.30		
Cost per bushel	$ 0.25		
Net returns per bushel	$ 0.05		

[1] Includes hotbeds and cold frames.
[2] Sacks will last two years, only one half of the cost is charged.
[3] Does not include truck expense incurred in hauling off starch potatoes.
[4] Includes depreciation on machinery and cost of blacksmithing.

The total value of starch potatoes per acre was $49.80; the net return averaged $7.92 per acre. It is important to note that if the producer owned his land and workstock and used his own or family labor altogether, he would have received, in addition to the $7.92 net return per acre, 10 cents per hour for his own labor, 5 cents per hour for his horse labor, and $3.65 rent per acre on the land used. The price received for starch potatoes was set at 30 cents per bushel and did not change during the year. The cost of production per bushel was 25 cents, leaving a net return of 5 cents per bushel.

The results of this study indicate that the returns from sweetpotatoes was considerably higher than the returns from cotton. Since sweetpotatoes for starch have been produced for only five years in this area, it is probable that increasing yields will be found under favorable conditions from year to year. Cotton, however, will not increase its yield to a very great extent. This will widen the margin that sweetpotatoes have over cotton. The subsidy which is given starch potato producers is calculated in the returns to the starch potato enterprise, whereas AAA payments for cotton are not included in the cotton enterprise.

FARM CREDIT IN JONES COUNTY

Long Term

The farm mortgage debt on all farms studied amounted to 16.4 per cent of the total value of land and buildings of the farms. Forty-seven of the 100 farmers surveyed had mortgages against their farms, averaging $1,009 per farm mortgaged (table 30). The Federal Land Bank was by far the

Table 30. Long Term Credit, Jones County, Mississippi, 1939.

Source of credit	Number of farms	Per cent of credit furnished by each source	Total value of mortgages	Average indebtedness per farm
Federal Land Bank	38	86.2	40,877	1,076
Individuals	7	7.2	3,410	487
Local banks	2	6.6	3,140	1,570
All farms mortgaged	47	100.0	47,427	1,009
Farms with no mortgage	53	—	—	—
All farms	100	—	47,427	474

most important source of long-term credit, furnishing 86 per cent of the total long-term credit used. Other sources of credit were individuals and local banks. Taking all farms studied into consideration, the average mortgage indebtedness per farm was $474.

Short Term

Most farmers find it necessary at some time or other to use short-term or production credit for paying labor and purchasing farm supplies, such as fertilizer, feed and seed. These loans are for production purposes only, and are usually made for the period of crop turn-over, which in this section is from six to nine months.

Of the 100 farms studied, 39 farmers used short-term credit which average $256 per farm using credit (table 31). Taking all farms studied into consideration, the average amount of short-term credit used was $100 per farm. The Hattiesburg Production Loan Association and local banks were the most important sources of short-term credit. The Hattiesburg Production Loan Association furnished 50 per cent of the total short-term credit used, local banks 40 per cent, local stores 6 per cent, and other sources 4 per cent. The rate of interest charged by the Hattiesburg Production Loan Association was 4½ per cent for the actual time the credit was used, as compared to 8 per cent charged by local banks. The local stores increased the price of goods sold to credit purchasers over the price of goods sold to cash purchasers.

Table 31. Short Term Credit, Jones County, Mississippi, 1939.

Source of credit	Number of farms	Total amount of credit furnished by each source	Average amount of credit used per farm	Term	Rate of interest	Per cent of credit furnished by each source
Hattiesburg Production Credit Assn.	20	4,950	248	6-12 months	4½	49.6
Local bank	12	4,040	337	6-9 months	8	40.5
Local store	5	592	118	Until sale of crops	Increased price of goods	5.9
Other	2	400	200	—	—	4.0
All farms using credit	39	9,982	256	—	—	100.00
Farms using no credit	61	—	—	—	—	—
All farms	100	9,982	100	—	—	—

Bulletin No. 353 December, 1940

METHODS OF Field Curing Hay

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
MISSISSIPPI STATE COLLEGE
CLARENCE DORMAN, DIRECTOR
STATE COLLEGE, MISSISSIPPI

Summary and Conclusions

1. The practice of windrowing alfalfa hay aids a continuation of the natural physiological process of transpiration, resulting in a greater moisture loss for a day's period.

2. Double windrowing two to three hours after cut furnishes hay with a better color, larger percentages of leaves, and a lower moisture content at the end of the day.

3. Data indicate that the leaf of alfalfa plants aids greatly in lowering the moisture content of the entire plant.

4. Photomicrographs showed a reopening of the stomata following windrowing two hours after cut.

5. Hay if left in the field overnight should be left in such position as to expose smallest amount of hay surface.

6. The process of crushing large-stemmed hays such as Johnson grass and soybeans will permit a needed change in methods and time required in curing.

7. Leaves contain 60 to 90% of the proteins and vitamins of hay.

8. Crushed hay can be stored having a higher carotene content than mowed hay.

9. Crushed hay is as rich as mowed hay in proteins, sugars and dextrin, ether extract and ash.

10. Light, temperature, oxidative enzymes, copper, pH, relative humidity and the rate of drying were found to affect the manner carotene is lost from hays or hay plants.

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METHODS OF FIELD CURING HAY

By T. N. JONES, O. A. LEONARD, and I. E. HAMBLIN

Agricultural Engineering Department

Hay making is an important phase of farming almost everywhere in the world and especially in the United States.

In the south, where chief attention has been directed toward cotton production, the hay crop has been of smaller importance than in any other general agricultural section of the country. During recent years, however, there has been a marked trend in Mississippi and other cotton states toward a more diversified system of agriculture. Pastures have been enlarged and improved, livestock numbers have been increased, and about a million acres of cropland has been taken out of cotton production and put into production of food and feed crops.

The greater portion of this acreage released from cotton production is now devoted to the production of hay, and there has resulted a significant increase in the quantity of hay produced on the farms. Statistics published by the United States Department of Agriculture indicate that during the ten-year period ended in 1937 the average production of all hay in the state was 699,000 tons annually. In 1939, the total production of hay on Mississippi farms was 1,242,000 tons, an increase of nearly 100 percent.

Soybeans were more widely and extensively used than any other hay crop, yielding 370,000 tons. There were 192,000 tons of lespedeza hay produced in 1939, 172,000 tons of cowpea hay, 150,000 tons of alfalfa hay, 65,000 tons of sweet sorghum hay, and 102,000 tons of wild hay. The classification lists miscellaneous tame hay totaling 221,000 tons, which probably includes the production of Johnson grass hay.

Most hay produced in Mississippi is consumed on the farm where grown; and, while relatively small surplus quantities are marketed throughout this state, two sections of Mississippi have expanded rapidly in commercial hay production during recent years. The Yazoo-Mississippi delta produces large quantities of alfalfa hay and increasing quantities of soybean hay, and the "Black Belt", or prairie area, produces large quantities of Johnson grass hay and less important quantities of alfalfa hay.

Statistics relating the volume of hay marketed through commercial channels are incomplete. For about ten years the Federal-State hay inspection service has been available to growers and shippers in Mississippi, and it is thought that the inspections have been made of practically all carlot shipments of hay. Statistics made available by the State Department of Agriculture, Jackson, Miss., show that carlot shipments of inspected hay have increased from 125 carloads in 1938 to 440 carloads during 1940.

The 1939 total production of hay is equivalent to approximately four tons per farm. The production is not evenly distributed, however, and on a very large number of farms in the state there is always a distinct shortage of hay needed to feed farm animals. Nevertheless, at normal market evaluation, the hay crop is of considerable economic importance, its value being exceeded only by lint cotton, cotton seed, and corn.

Perhaps less research has been done throughout the country on hay than on any other field crop of equal importance. Coupled with this continuing need of information on hay making, is the fact that in Mississippi many thousands of farmers are making hay for the first time in a more than incidental sense. It is hoped that this report may be of value not only to virtual beginners in the business of hay production, but also to large scale commercial producers.

Problems in Haymaking

While much work has been done on the curing of hay, both artificially and by improved field methods, knowledge of the relationship between the fundamental factors governing water movement and removal in hay plants is limited. Curing hay in good weather does not present such a problem; in bad weather the difficulties may be insuperable. Persistent wet weather is the greatest handicap to the hay-maker, and in the humid climate of the southern states, the hazard of frequent rains is always great. A study of weather records at State College shows that during the hay season (April to October, inclusive), rain may be expected on an average of every four and one-half days with an average of .51 inches per rain.

During rainy weather there is considerable loss in weight, aside from any loss of quality that may result. In many instances the deterioration in value of the hay is so great as to make it useless for livestock, in which case many tons of hay have been burned in the field as the easiest means of disposal.

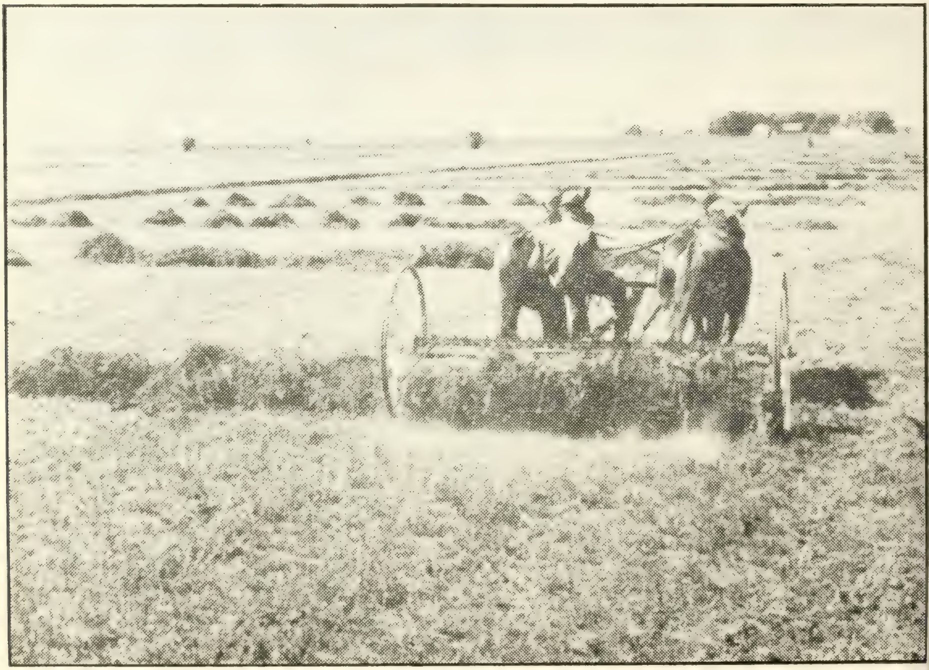


FIGURE 1—Dump rake, such as found on numerous Mississippi farms, may be used for windrowing by dumping before the mass of hay within the fingers becomes compacted.

The proper stage for cutting most hay crops is just prior to maturity. At this time they have just passed through the period of most rapid growth and are very succulent; the newly formed cells and tissues have not yet hardened, with the consequent decrease in moisture content to form the reenforcing structure for fruit support. There is in the living plant at this time a continous stream or mesh of water, the molecules of which are within and between cells from the deepest root tip to the edge of the uppermost leaf or shoot, and from the pith to the corky bark or surface of the stem. This water enters the plant through the root hairs and is drawn upward, mainly through woody xylem tissues, finally passing out through the leaves in the form of vapor into the surrounding atmosphere. This process of moisture loss by plants is known as transpiration, and under favorable conditions causes a movement of the water stream upward through the plant of at least two inches per minute. Thus, within a very few minutes, an hour at most, the water entering the root hair will be escaping from a stomatal pore of an uppermost leaf.

If plants cut for hay could be so handled as to preserve or promote this natural flow of plant moisture, the process of natural dehydration would defeat for all times the hazards presented by the time element. Thus, haymaking is usually a race against time, and hay of the highest quality and food value is quickly dried, quickly baled, and fed within a year.

The two main sources of loss in field cured hays are:

(1) Loss of leaves, the more valuable part of the hay. The better hays consist of 40% to 60% in weight of leaves; in turn, the leaves usually contain 70% to 80% of the feeding value of hay in protein, minerals and vitamins. The leaves are lost by cutting too late and by improper methods of curing and handling the hay.

(2) Loss by weathering. Since the stems dry slower than the leaves, it is essential that the hay crop be left in the field until the stems are dry enough for storage, which usually means that the

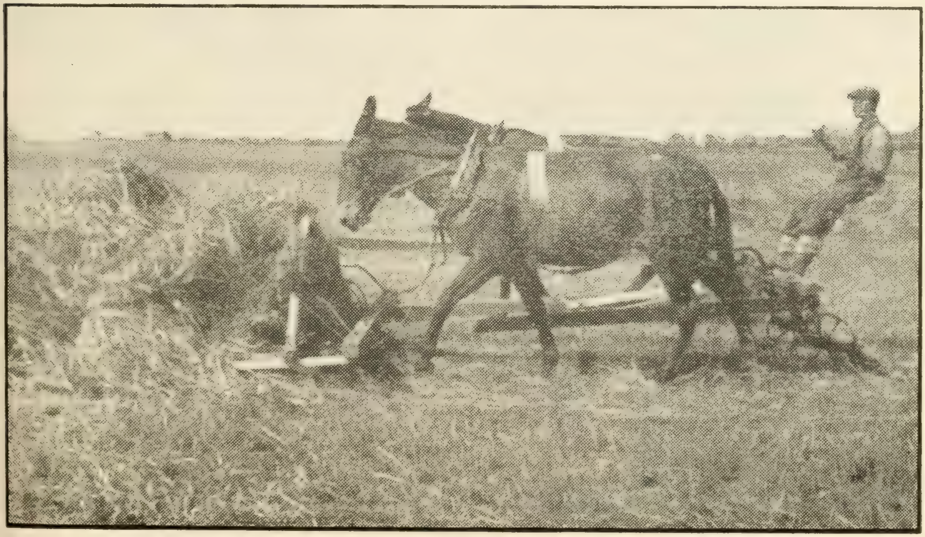


FIGURE 2—Push rake, an economical method of moving hay a short distance.

hay is left exposed to dew or rain for at least one night. When partially cured hay is exposed to dew or rain followed by hot sunshine, the proteins are greatly reduced plus shattering of leaves and discoloring of the hay plant.

Research in Haymaking

The Agriculture Engineering Departmen of the Mississippi Station has been conducting research in haymaking since 1931. These studies have sought to establish the fundamental explanation for the characteristic behavior of certain curing plants, to the end that methods of field handling may be formulated to hasten the natural process of drying.

The procedure followed in our experimental work consisted essentially of curing hay in the field by different methods in common use, measuring the factors involved in curing, and determining the interrelationships between these factors and the grade or feeding value of the hay produced.

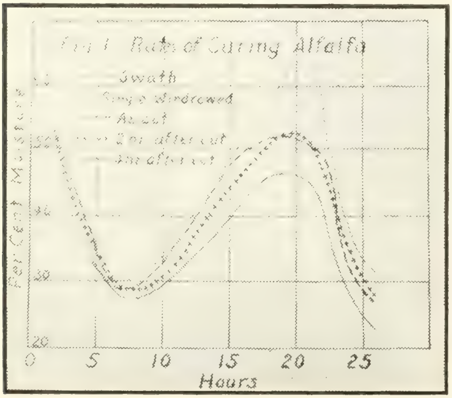
Among the principal methods studied in field handling of hay were:

1. In the swath.
2. In single and double windrows raked at 3 separate intervals.
    (a.) At time of cutting
    (b.) Two hours after cutting
    (c.) Four hours after cutting
3. Crushed and uncrushed

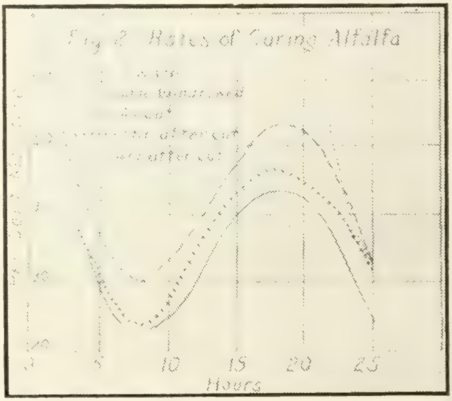
From these different positions. representative samples were taken in duplicate at one hour intervals from time of cutting, placed in 25-pound paper bags, and weighed immediately. On several occasions these samples were taken on through the night and the following day to determine the physiological and natural changes of the plant during that period. These samples with the wet weight recorded were brought to the laboratory, where they were oven-dried and the percentage of moisture determined. At the time each sample was taken, the temperature, relative humidity, time of day, wind velocity, and moisture content of soil were recorded and used in the construction of curves by multiple correlation. These curves as shown in graphs 1 and 2 show the rates of curing alfalfa in seven field methods.

Mower-Crusher Constructed

The principle of crushing plants to hasten the curing process was new and relatively untried at the beginning of



GRAPH 1—Rates of curing alfalfa in the swath as compared to single windrowed as cut, and single windrowed two and four hours after cut; and the amount of moisture absorbed overnight.



GRAPH 2—Rates of curing alfalfa in the swath as compared to double windrowed as cut, and double windrowed two and four hours after cut; and the amount of moisture absorbed overnight.

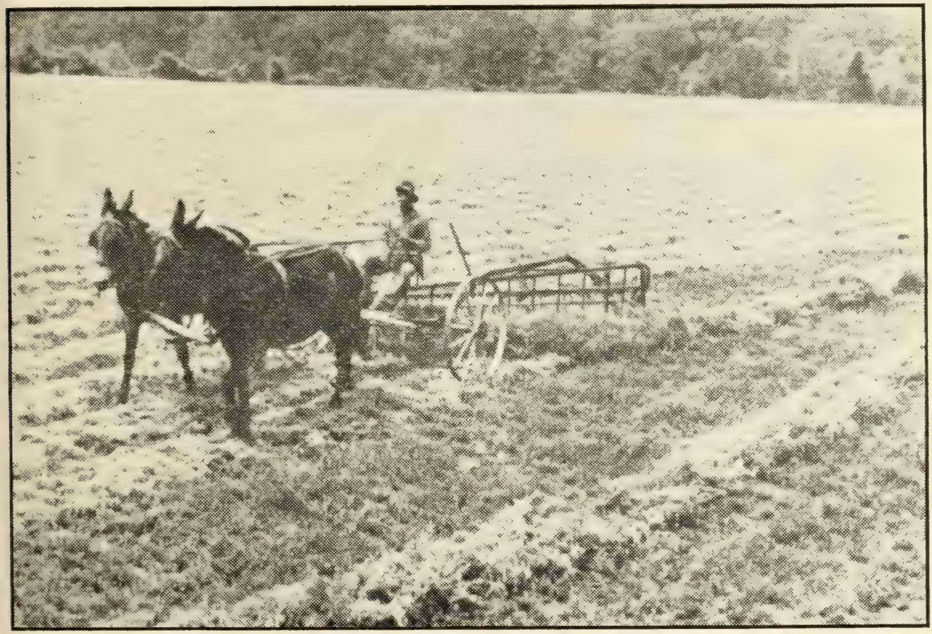


FIGURE 3—Side delivery rake doing a good job of raking.

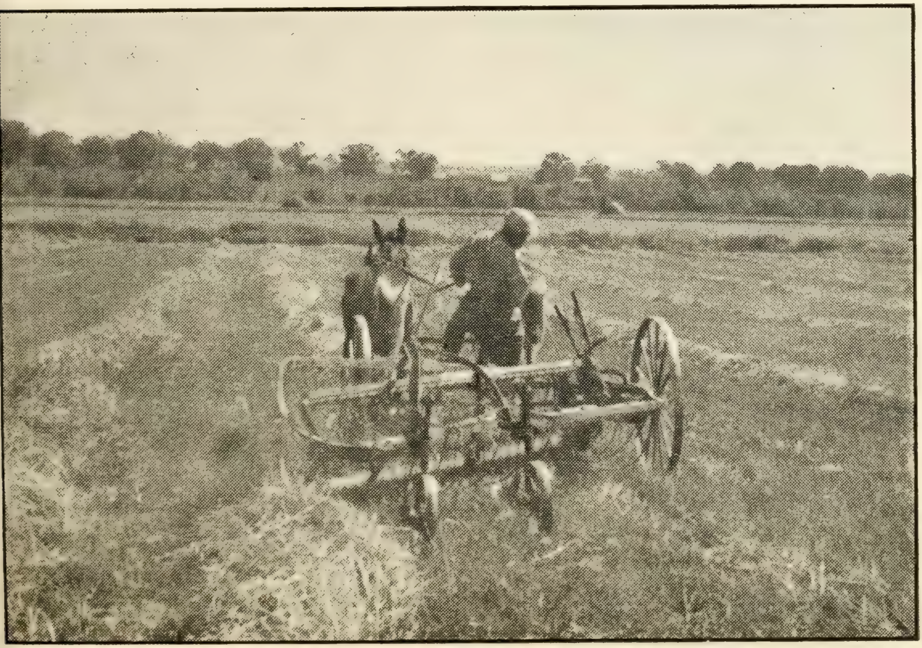


FIGURE 3-A—Another view of the side delivery rake in operation

these experiments and is only now ready to emerge from the experimental stage. No machine was available through commercial channels for crushing the mown plants at the beginning of the work, and a pioneer crusher was designed and constructed by our department. Its early use revealed major defects and a second and improved mower-crusher was similarly designed and constructed in 1933. Further basic improvements are incorporated in the machine designed and constructed in 1940.

A comprehesive report of these ten years work in hay making is soon to be published in technical bulletin numbere 27, entitled "Methods of Field Curing Hay." From the viewpoint of the average good farmer, the essential features of the technical paper are included in the present bulletin. It may be observed that three principal phases of the subject are herein discussed:

(1) An analysis of field practices which may be adopted by farmers everywhere, whether utilizing small unit equipment or whether using specialized large-scale equipment.

(2) A study of crushing the hay plants at the time of cutting, a process especially advantageous to large scale producers.

(3) A practical discussion of hay making practices which yield the maximum food value in hay.

I. CURING HAY BY MEANS OF COMMONLY USED EQUIPMENT

Common practices in haymaking may be summed up as follows:

(1) The hay is mowed.

(2) The mowed plants lie in the swath as they fall from the mower blade until partially or completely cured.

(3) After partial or complete curing, the hay is raked into windrows, either for convenience in handling, or to complete the curing process.

(4) The cured hay is stacked, or stored loose, or baled.

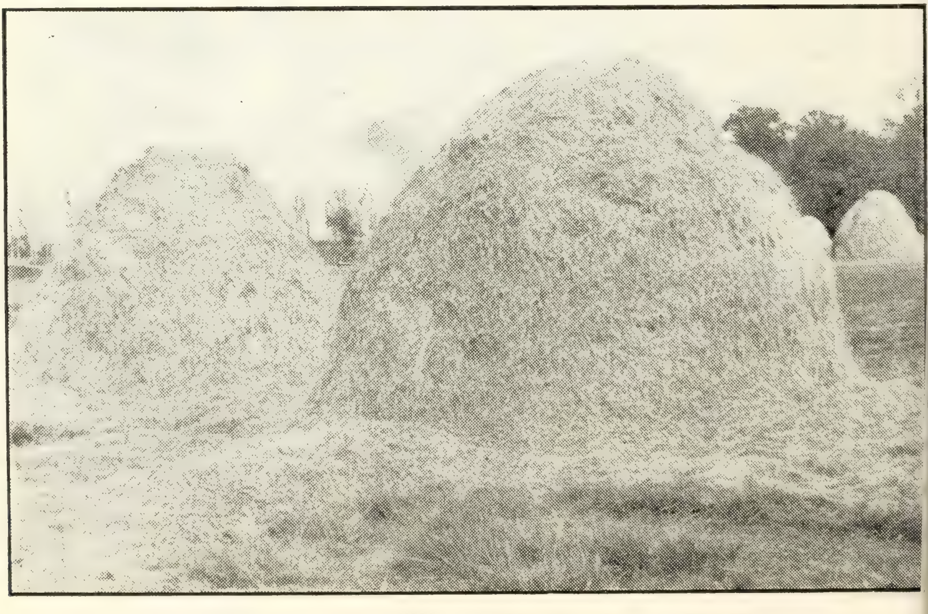


FIGURE 4—Hay stacks—a wasteful method of keeping hay.

In commercial hay producing areas of the state it is reported that hay is commonly windrowed while only partially cured, thus following good haymaking practices. In non-commercial areas it is reported that hay is commonly left in the swath until the cure is thought to be complete, thus resulting in excessive loss of leaves and other damage.

Thus it would appear that somewhere in the execution of these four simple haymaking practices is the difference between marketable hay and unmarketable hay, between good hay and poor hay.

Our first experiment was, in reality, a measure of results of varying the execution of these common practices. Alfalfa, at the proper stage of growth, was mowed in the morning from 8 to 9 o'clock. A portion of it was left in the swath to cure. The remainder was windrowed. Separate plots were single windrowed (1) as cut, (2) two hours after cutting, and (3) four hours after cutting. Other separate plots were double windrowed as (1) cut, (2) two hours after cutting, and (3) four hours after cutting. The percent of moisture was determined on all plots as cut, two hours after cutting, four hours after cutting, eight hours after cutting, twenty hours after cutting and twenty-five hours after cutting. The percentage of moisture in hay varies considerably, but 20% moisture is generally thought low enough for safety in baling, ricking, or storage.

Double Windrowing Recommended

Results of studies on the rates of curing by the different field methods show that double windrowing two or three hours after cutting furnished a cured hay with a more desirable color, a larger percentage of leaves remaining on the stems, and a lower moisture content at the end of the day due to the continuous activity of stomata.

The windrows, as raked with the side-delivery rake, were rolls of an average diameter of 1½ and 3 feet respectively, for single and double; and the samples taken consisted of a full cross section of the roll so that it would be representative of all the hay within the windrow.

Alfalfa hay double windrowed two hours after cutting, it will be observed by reference to table 1, contained 17 percent moisture after twenty-five hours, and was therefore ready for baling the day after cutting. All the plots wind-

TABLE 1—RATE OF NATURAL DRYING ALFALFA HAY CUT FROM 8 TO 9 A. M.

Method of Handling	Per Cent Moisture As Cut	2 Hrs. After Cutting	4 Hrs. After Cutting	8 Hrs. After Cutting	20 Hrs. After Cutting	25 Hrs. After Cutting
Swath	70	60	44	26	46	25
Single Windrowed As Cut	70	62	38	21	38	22
Double Windrowed As Cut	70	64	34	26	38	27
Single Windrowed 2 Hrs. After Cut	70	60	40	22	37	22
Double Windrowed 2 Hrs. After Cut	70	60	32	18.5	30	17
Single Windrowed 4 Hrs. After Cut	70	60	44	21	25	21
Double Windrowed 4 Hrs. After Cut	70	60	44	20	30	20.5

rowed two hours or four hours after cutting were dry enough for baling at the end of the day after cutting. Hay which remained in the swath without windrowing was but little dryer after twenty-five hours than after eight hours, and required an additional day to cure.

As will be pointed out in the next section, more rapid drying of all hays should occur in the double windrow than in the swath, at least in hot weather and under low relative humidity conditions.

Even without the advantage of more rapid drying, double windrowing two to three hours after mowing should be practiced. The advantages of having a hay better in color, higher in carotene and fats, and with more leaves, are considerable. Sunlight has decided destructive effect upon carotene and the fatty materials (ether extract); hence, double windrowing will protect most of the hay from the intense and destructive rays of the sun, as will be pointed out later. Hay windrowed within two to four hours after cutting will not shatter the leaves as readily as hay left longer in the swath. Since the leaves represent the most valuable part of the plant from a nutritional point of view, saving the leaves is of utmost advantage.

Influence of Leaves

There is a rather prevalent opinion, and one that has frequently found expression in agricultural literature, that forage crops cure more quickly if handled in such a way as to maintain the leaves in as fresh condition as possible until enough time has elapsed to permit the stems to lose much or most of their moisture. An understanding of this principle is of high importance to hay producers.

If attached leaves remove and transpire water from stems, these leaves should dry more slowly than if they had

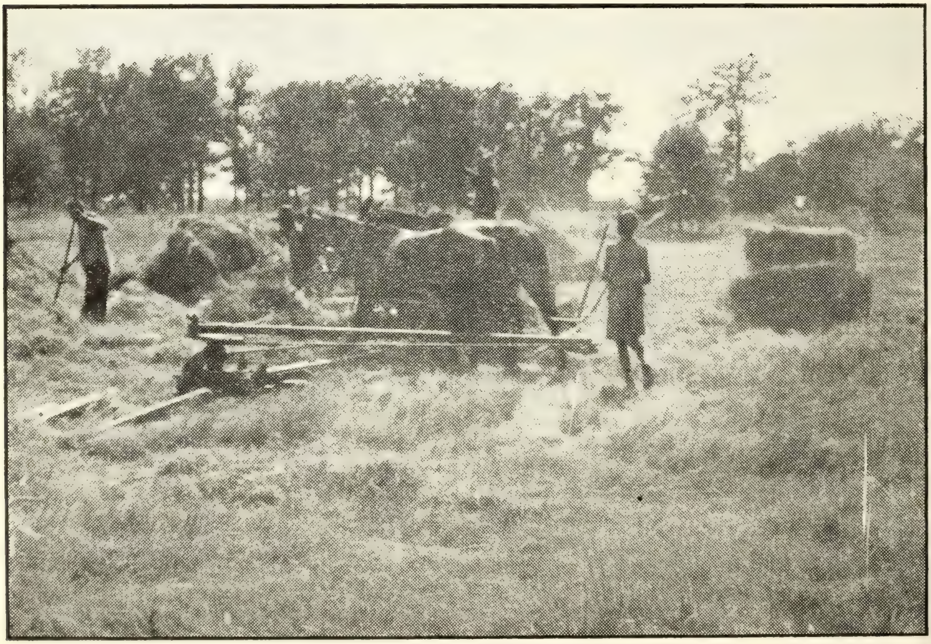


FIGURE 5—A horse power baler.

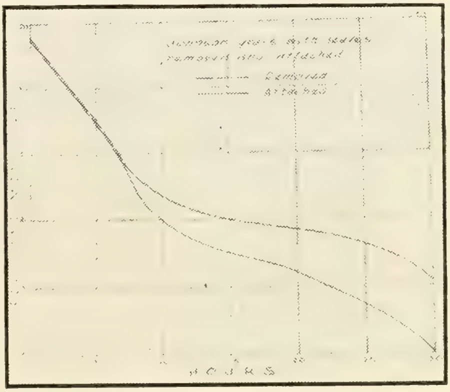
been detached. In one test on sweet clover, leaves attached to a plant contained 58 percent moisture after drying 30 hours in the laboratory, while detached leaves contained but 15 percent moisture. In field tests, significant differences also have been observed.

In a test to determine the value of leaves in removing water from stems, leaves were removed from a number of cut sweetclover plants. The upper six inches of one-half the plants was removed by clipping, and a separate study made. All cut ends were paraffined. After drying in the laboratory 70 hours (table 2), the entire stem, which had the leaves attached, had lost 71% of the water initially present in the stem; and of this water loss, at least 84% had been lost through the leaves and 16 percent from the stem. The small-stemmed upper 6 inches had lost 66 percent of the water in the stem, of which at least 40 percent had been lost through the leaves and 60 percent or less through the stems. The larger stem for the entire plant lost more of its water through the leaves than did the smaller stem on the upper part of the plant.

Alfalfa and Johnson grass with the leaves removed (graph 3) dried more slowly than plants with leaves attached. These data demonstrate again that leaves may have considerable influence on removing water from stems. Experiments of this type were conducted by Kiesselbach and Anderson (1926) on alfalfa, with smaller differences than we obtained.

Leaves on a stem sometimes dry rather uniformly, while at other times there is a marked difference in the rates of drying of individual leaves. After drying 72 hours, leaves on a branch of sweetclover from base to tip had the following moisture contents: 13.3 percent, 25.4 percent, 52.7 percent, 58.6 percent, and 61 percent respectively. (Initial moisture was about the same.)

Similar differences were observed for Johnson grass, if studied before the panicle had appeared. A movement of moisture will take place from base to tip in stems of sweetclover and Johnson grass. All except the uppermost leaves were removed from sweetclover plants, and then the tops of one-half these plants were removed and all cut ends paraffined. The plants with the lower leafless portion of the stem at-



GRAPH 3—Difference in rates of drying Johnson grass with leaves removed and with leaves attached.

TABLE 2—LOSS OF MOISTURE FROM SWEET CLOVER STEMS AS INFLUENCED BY LEAVES

	Whole stem; % Moisture	% of Initial Water in Stems Lost	Upper 6 in. of stem; % Moisture	% of Initial Water in Stems Lost
Initial Moisture	70.4	----	85.1	----
Dry 18 Hours				
Leaves on Stem	63.0	29	79.0	34
Leaves off Stem	71.6	0	84.9	2
Dry 70 Hours				
Leaves on Stem	41.0	71	61.0	66
Leaves off Stem	68.0	11	78.0	38

tached had leaves containing 70 percent moisture and stems containing 82 percent moisture 44 hours after the experiment was started. Those plants with the lower leafless portion of the stem removed had leaves and stems containing 34% and 57% moisture respectively, after the same period.

A rough test in determining whether Johnson grass has cured sufficiently is to take a handful of hay and twist the upper portion to see if there is any free moisture. One reason for the moisture content of the upper portion of the stem (before emergence of panicle) remaining higher than in other parts is because of moisture movement from the base to the apex; therefore, the top is the last to dry.

II. CRUSHING HAY TO HASTEN THE CURING PROCESS

In an effort to further hasten the process of curing hay, an experimental machine for crushing the stems of the hay plants was developed by the Agricultural Engineering Department of the Mississippi Station.

The first factor to determine in the crushing process was the proper time to crush the hay; in other words, should the hay be crushed at time of cutting, or one, two, three or four hours after cutting. Therefore, the first machine designed and built by the Experiment Station was one with a pick-up attachment so that the hay could be picked up from the ground after mowing.

From tests in 1932 it was well established that the proper time to crush hay was at the time of cutting. With this in mind the first mower-crusher developed by this department was built and proved in 1933, (figure 9). This machine has been improved and tested during the years since. This crusher was power

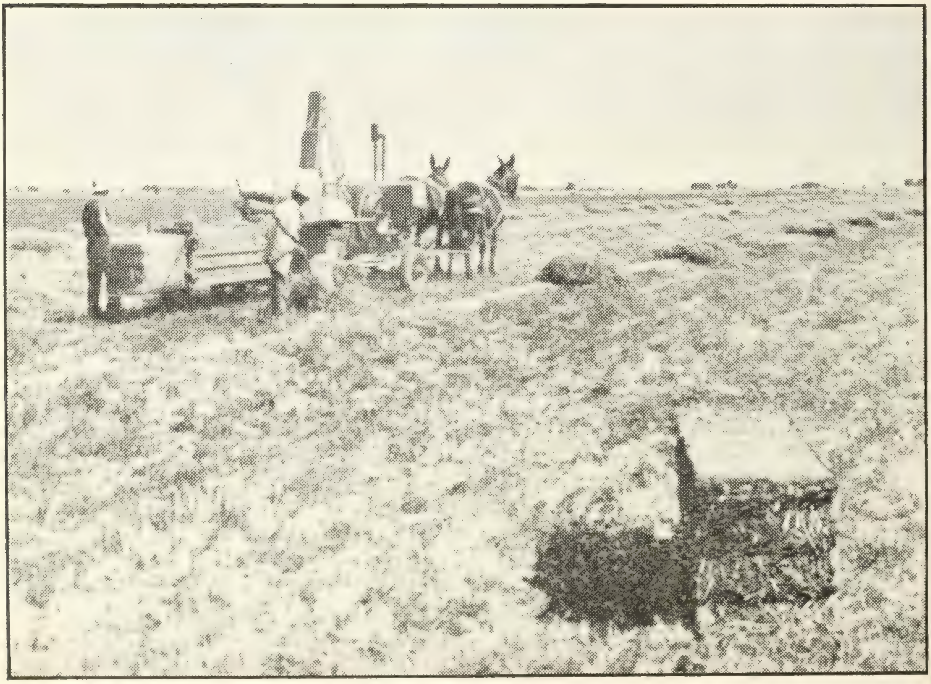


FIGURE 6—Gasoline engine power baler.

take-off driven, and required approximately 10% to 15% more power than the tractor mower alone. The crusher rolls were six inches in diameter and the pressure was controlled by compression springs. The springs should be at least 18 inches long, soft and flexible, so that hard objects such as stalks may be permitted to pass through the rolls. The rolls were made of six inch steel pipe, and were machined round.

During the year 1940 another crushing machine was constructed, which was power take-off driven but used as an attachment to the regular tractor mower. The frame of this machine was supported from the axle of the row-crop type tractor and two castor wheels which permit mowing and crushing in one operation. One man operated the tractor and mower-crusher, and the mowing process is not materially slowed down by the crushing mechanism. See figure 10.

This machine gave marked results in reducing the curing time of large stem hays during the 1940 season.

We have already shown that the leaf will lose water considerably faster than the stem if the two are separated. A leaf which is attached to the stem will not become dry as rapidly as one which is loose, since it has the extra burden of removing some of the water from the stem. Crushing machines have been developed to hasten the rate of drying of the slower drying stems. Since moisture in leaf and stem is roughly interdependent, a more rapidly dried stem also means a more rapidly dried leaf, a fact which we have always observed in the field, and a fact which determines the manner carotene is lost in crushed and uncrushed hays, as will be pointed out later.

Crushing Johnson Grass

Johnson grass that was cut at 10:00 a. m. contained only 25 percent moisture at 5:00 p. m., a period of only seven

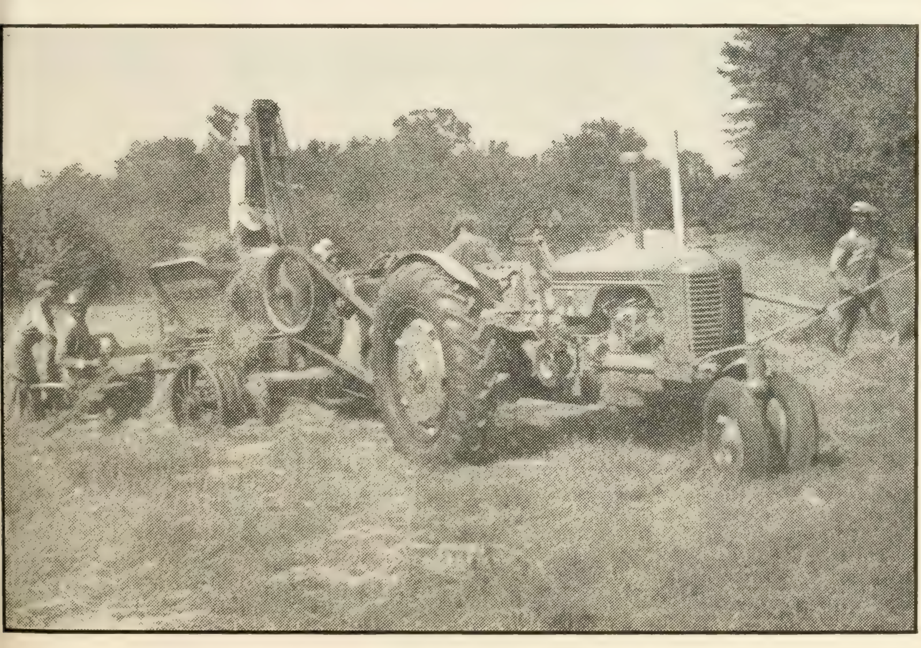


FIGURE 7—The direct hitch tractor power, take-off driven baler.

hours; whereas the uncrushed Johnson grass containel 37 percent moisture at the same time seven hours after cutting. In similar tests where the hay was cut earlier, the moisture content was brought below 20 percent by 5:00 p. m. Hay with a moisture content of 25 percent or less may be stored loose or put in small cocks or stacks, thus eliminating the greater portion of the hay being exposed to dew. Naturally, when hay is cured in this manner, it will have better color, better grade, retain more proteins, and be more palatable.

Experiments revealed that medium and heavy crushing brought about practically the same rate of drying.

The above evidence indicates that in crushing hay the pressure should be adjusted for the particlar hay in such a way that most of the stems are crushed, but that further pressure, unless greatly increased, will not appreciably affect the rate of drying of the hay.

No Loss in Food Constituents

The question arises as to what loss, if any, occurs in the food constituents by crushing. It will later be pointed out that in crushed stems of Johnson grass a weight loss of 1% usually was observed, and this loss was mainly accountable through evaporation of the water squeezed out of the stems and covering the surfaces. Analyses of alfalfa and Johnson grass show that there was no material loss due to crushing in the content of crude (total) protein, soluble protein, soluble carbohydrates (sugars and dextrin), ether extract, and ash.

Chemical analyses in other tests also revealed that there was no loss in the chemical constituents due to crushing. However, there was an increase in soluble proteins (soluble nitrogen compounds) due to curing (drying), and a

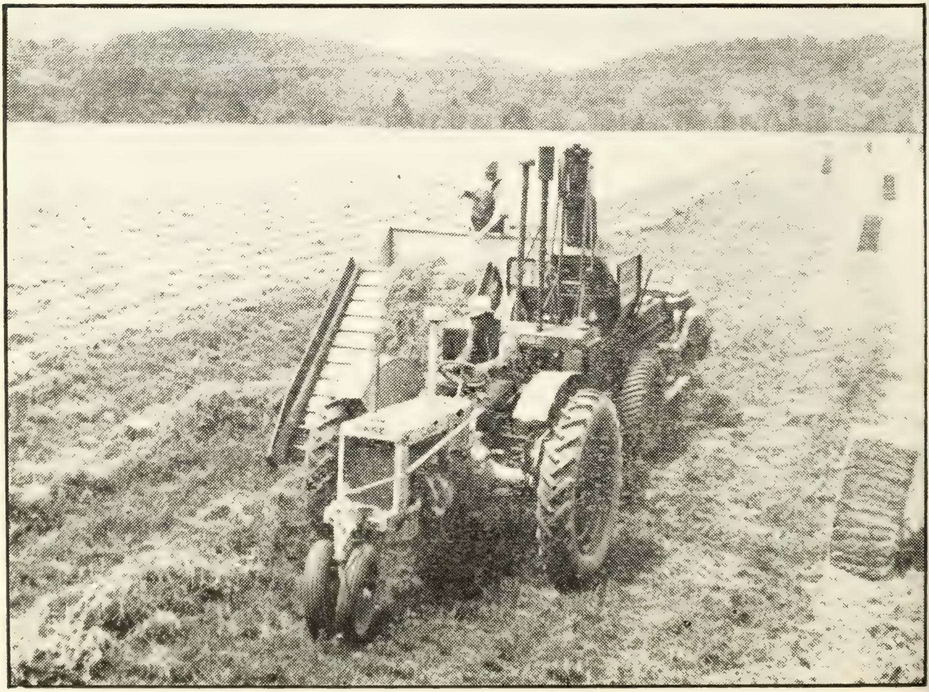


FIGURE 8—The modern pick-up baler with auxiliary engine.

slight decrease in soluble carbohydrates due to respiration. These results were expected and are also well known.

Studies were conducted to determine whether crushed stems were poorer in carotene than uncrushed stems. The data revealed that crushed stems were as rich in carotene as mowed stems by the time the mowed plants were dry.

The leaves behaved in a similar manner. The reason carotene is lost in this manner will be explained in the technical bulletin under the heading "Carotene As Affected by Rate of Drying".

Most of the experiments on crushing Johnson grass were conducted at the West Point Forage Crops Field. In the course of the last several years a variety of such tests have been made, using different kinds of experimental crushing machines.

Drying Process Hastened

Johnson grass has been crushed under various weather conditions and also under various conditions of plant growth. The influence of some of these variable factors on the rates of curing will be considered.

Other studies show the effect of mowing and crushing Johnson grass. The hay was crushed with a commercal crusher, and by 2:20 P. M. (only 3 hours and 20 minutes) it was ready for baling, whereas, the mowed hay was not as dry the following afternoon at the same time. The short period of time required for curing of the crushed hay was due to the low initial moisture content of the grass, the thinness of the stand, and the good drying conditions made possible by the hot, sunshiny day and moderate relative humidity. Carotene was more

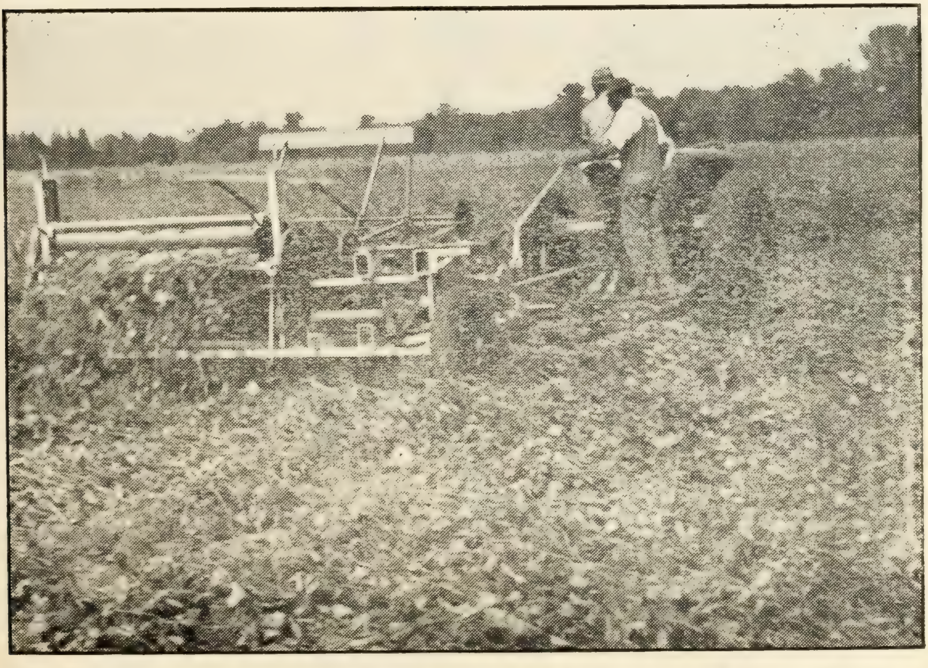


FIGURE 9—The mower-crusher designed and constructed by the Agricultural Engineering Department in 1933, operating on soybeans.

abundant in the mowed than in the crushed hay at the end of the first day's drying, but about the same the following afternoon. It is interesting to note that the contents of moisture and carotene of the hay are correlated.

The stands of Johnson grass reported thus far were thin and stems rather small. Table No. 4 shows an experiment conducted with large-stemmed Johnson grass which was very succulent and had about one-third the panicle showing. Approximately two-fifths of the fresh weight was leaves and three-fifths stems. The weather and other conditions were ideal for curing hay: relative humidity was low, temperature high, and the ground dry. The mowed hay still contained 52% moisture after drying in the swath seven hours, while the crushed hay contained 27% moisture. The relative humidity under the hay, which was piled deep on the ground, was 10% higher than the relative humidity of the air. Even this humidity favored rapid transpiration. By 1:00 P. M. the

TABLE 3—EFFECT OF MOWING AND CRUSHING JOHNSON GRASS ON ITS CHEMICAL COMPOSITION

	Crude Protein % Dry Wt.	Soluble Protein % Dry Wt.	Soluble Carbohydrates % Dry Wt.	Ether Extract % Dry Wt.	Ash % Dry Wt.
Johnson Grass					
Fresh	5.25	0.37	4.98	.....	6.4
Mowed	5.31	0.82	4.65	1.90	6.3
Crushed	5.37	0.69	3.91	1.83	6.4
Alfalfa					
Fresh	22.93	3.24	5.91	....	13.0
Mowed	22.93	6.81	4.18	4.60	10.0
Crushed	22.56	4.75	4.70	5.96	13.0

TABLE 4—COMPARISON OF DRYING RATES ON CRUSHED AND MOWED JOHNSON GRASS

					Mower		Commercial Crusher	
Time	Temp. C.	Relative Humidity	Light In Ft. Candles	Wind	Moisture, %	Carotene p.p.m. Dry Wt.	Moisture %	Carotene p.p.m. Dry Wt.
First Day								
10:00 A. M.	29.0	42	11,859	Still	66.8	125	66.8	125
11:00 A. M.	29.4	42	12,283	Still	62.9	......	56.4	....
12 Noon	30.0	38	12,283	Still	61.2	......	55.4	....
1:00 P. M.	33.4	32	12,390	Light Breeze	59.6	......	46.0	....
2:00 P. M.	32.8	34	11,151	Still	56.5	......	37.9	....
3:00 P. M.	29.4	34	9,800	Still	54.0	......	35.0	......
4:00 P. M.	27.2	37	6,500	Still	52.9	......	28.3	......
5:00 P. M.	27.0	42	4,200	Still	52.0	......	27.0	......
Second Day								
10:00 A. M.	30.6	44	11,682	Still	50.5	....	25.7	......
11:00 A. M.	31.2	38	11,682	Still	51.8	....	20.9	....
12 Noon	32.8	34	12,036	Still	43.7	......	20.0	68
1:00 P. M.	37.4	28	11,859	Still	39.5	......	13.4	......
2:00 P. M.	35.2	27	11,328	Still	40.4	......	12.0	......
3:00 P. M.	34.0	29	9,200	Still	44.5	......	11.2	......
4:00 P. M.	32.6	32	2,600	Still	35.8	......	20.0	......
5:00 P. M. Rain	29.5	35	1,600	Very Windy	39.4	53	15.4	42
Sixth Day								
3:00 P. M.	....	....	....	......	18.0	18	......	......

next day the crushed hay was ready for baling, containing 13.4% moisture, while the mowed hay still contained 40% moisture. Because of a light shower, dew and cloudy weather, the mowed hay was not ready for handling until five days after cutting. The crushed hay could have been baled at a time when its carotene was 68 p. p. m. (parts per million) while the mowed hay could not have been thus handled before its carotene content was 18 p. p. m. on a dry weight basis.

At cutting, when the moisture content was high, the carotene content was high, and as moisture was reduced, the carotene content decreased. However, when the mowed hay was ready for baling six days after cutting, the carotene content was only 18 p. p. m. The crushed hay was ready for baling at noon the day after cutting, and then contained 68 p. p. m. carotene, nearly four times as much as the mown hay.

It was found in frequent tests that hay could have been baled the day it was cut and crushed, if dried in the swath and if the stems were small; however, if the stems were medium size or large, two days might be required for curing under favorable weather conditions.

Crushing Alfalfa

Several crushing tests have been made on alfalfa with the data showing that the curing time may be reduced about one-third, depending, of course, upon the size of stems and weather conditions. By crushing alfalfa one may expect with good weather conditions to cock the hay the first day, thereby preventing much damage from dew and lowering greatly the chances of the damage by rain.

Crushing Soybeans

Soybeans crushed with the first crusher reached a moisture content of 27

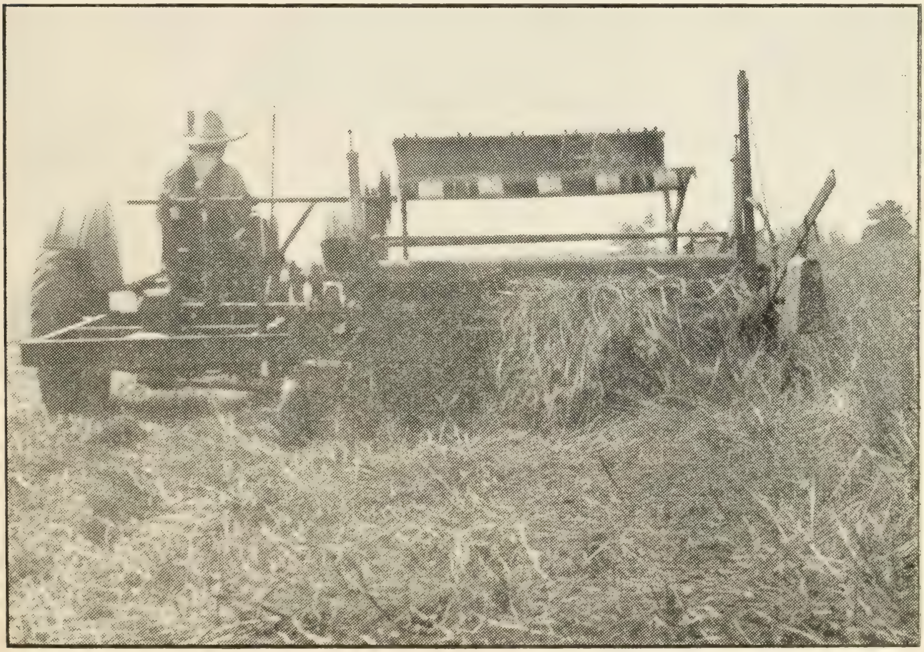


FIGURE 10—The 1940 improved mower-crusher, also designed and built by the Agricultural Engineering Department, operating on Johnson grass.

percent at the end of six hours after cutting and crushing, while the uncrushed hay still contained 42 percent moisture at the end of the same period. These tests were made in October after the days had shortened considerably and the temperature was below the summer average.

It has already been pointed out that large-stemmed Johnson grass (table 4) dried more slowly than that with smaller stems, and that crushing had a more decided influence on reducing the curing time on these large-stemmed plants than on the smaller ones. The same relationship is true for small and large-stemmed soybeans, both at the same relative stage of growth, but the one more vigorous than the other.

Crushing tests were made on small-stemmed soybeans, using the commercial crusher. The crushed small-stemmed plants had decreased from 70 percent moisture to 19% moisture in seven hours curing, and thus were ready for baling the first day. The mowed plants had 40% moisture after seven hours drying. The following afternoon at 5:00 p. m. the mowed soybean plants contained 18% moisture and were ready for baling. Crushing thus reduced the curing period by 50%. The crushed hay could have been baled when its carotene content was 100 p.p.m., and the mowed hay when its carotene content was 52 p.p.m. Carotene in the fresh soybeans was 167 p.p m., dry weight basis.

Large-stemmed soybeans are influenced more by crushing than small-stemmed soybeans, although a longer curing period is required. By 1:50 p. m. of the second day after cutting, the crushed soybeans were ready to bale (table 5) while the mowed soybeans were not ready to handle until five curing days after being cut. The curing period was reduced about 70%. It is interesting to observe that crushed large-stemmed soybeans dried more rapidly than uncrushed small-stemmed plants. The crushed large-stemmed soybeans at baling time had lost a larger percentage of their carotene than had the

TABLE 5—COMPARISON OF DRYING RATES OF CRUSHED AND MOWED SOYBEANS, PLANTS LARGE

					Mower		Commercial Crusher	
Time	Temp. C.	Relative Humidity	Light In Ft. Candles	Wind	Moisture, %	Carotene p.p.m. Dry Wt.	Moisture %	Carotene p.p.m. Dry Wt.
First Day								
10:30 A. M.	21.5	33	10,600	Mod.	67 5	125	67.5	125
11:30 A. M.	22.8	34	11,000	Mod.	64.9	-----	61.2	-----
1:30 P. M.	24.0	31	11,000	Mod.	60.7	-----	38.4	-----
2:30 P. M.	24.0	30	11,000	Mod.	55.2	-----	38.2	-----
3:30 P. M.	23.4	32	11,000	Breeze	55.1	-----	40.0	-----
4:30 P. M.	22.2	34	8,100	Low Breeze	55 3	-----	32.7	-----
5:30 P. M.	19.6	36	1,700	Low Breeze	47.5	-----	35.8	-----
Second Day								
10:50 A. M.	26.0	36	11,000	Light Breeze	42.8	-----	24.2	-----
12:50 A. M.	27.6	29	11,000	Still	42.1	-----	21.6	-----
1:50 P. M.	27 6	31	11,000	Still	44.9	-----	17.8	-----
2:50 P. M.	26.2	31	11,000	Still	38.8	-----	8.8	-----
4:50 P. M.	19.5	43	4,500	Still	37.0	60	11.3	58
Third Day								
10:30 A. M.	26.0	40	10,000	Still	36.5	-----	14.1	-----
Fifth Day								
5:00 P. M.		--	------	------	18.5	38	----	-----

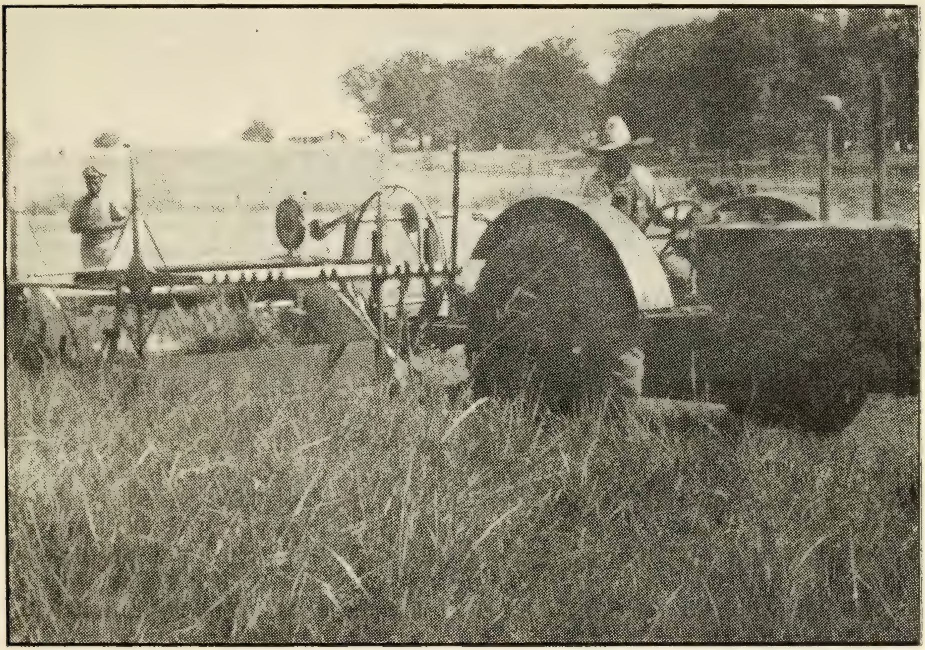


FIGURE 10-A—Another view of the direct hitch, power take-off driven crusher using regular tractor mower.

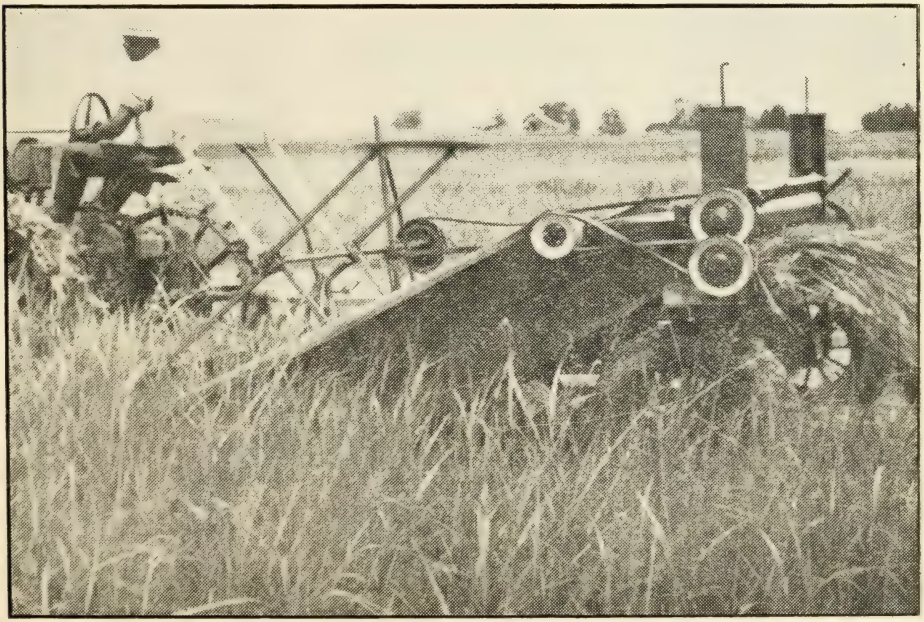


FIGURE 10-B—Close-up, showing crushed hay passing through the mower-crusher

small-stemmed plants.

Figure 13 shows cross section views of hay from crushed and uncrushed Johnson grass

Crushing Kudzu

Kudzu is a promising perennial legume which may be increasingly used as a hay plant. It is a soil conserving plant and Kudzu hay is rather rich in protein. When compared with other hay plants Kudzu may be disadvantaged because it yields only one or two cuttings per year; on the other hand, an advantage of kudzu is that it may be cut any time desired from mid-June until frost occurs. Limited experimental data indicates that kudzu grows well on the well-drained sandy soil areas where alfalfa and Johnson grass are difficult to produce and where the need is great for an efficient hay plant.

Kudzu was crushed with the commercial crusher. This was the only cutting made on this ground during the year, hence, some of the vines were woody but there were some younger stems and leaves. Table 6 gives the drying rates of crushed and mowed kudzu. Cut at 9:20 a. m., by 2:20 p. m. the crushed kudzu was ready to bale, while the mowed kudzu was not ready until about 11:00 a. m. the next morning. Crushing produced favorable results on kudzu. Possibly younger kudzu would respond even more favorably to crushing.

Crushing Sweetpotato Vines

Crushing hastens the rate moisture is lost from sweetpotato vines, as with other plants tested. However, even with crushing, curing is slow because the vines are high in moisture and cannot be harvested until the roots are ready to be dug in the fall, when the days are cool and short. In a crushing test at Laurel, Miss., on October 22, 1940, crushed vines decreased about 20% in moisture during six hours drying in the field, while the mowed vines decreased about 10%. These figures are only approximate, since there was considerable variability in the samples. The following forenoon was cloudy and cool, hence, there was little additional drying in either the mowed or crushed samples.

Protein was 7.78 percent and carotene was 253 p.p.m. (both on dry weight basis) in the fresh vines. The crushed vines had lost two-thirds and the mowed vines had lost one-half their carotene by noon of the second day. The moisture content of the crushed vines was 55 to 58 per-

TABLE 6—COMPARISON OF DRYING RATES OF CRUSHED AND MOWED KUDZU

					Mower		Commercial Crusher	
Time	Temp. C.	Relative Humidity	Light In Ft. Candles	Wind	Moisture, %	Carotene p.p.m. Dry Wt.	Moisture %	Carotene p.p.m. Dry Wt.
First Day								
9:20 A. M.	22.0	42	11,000	Light Breeze	56.6	151	56.6	151
10:20 A. M.	25.8	37	11,000	Light Breeze	55.6	-----	53.0	-----
11:20 A. M.	27.4	34	11,000	Light Breeze	50.3	-----	46.0	-----
1:20 P. M.	27.6	29	11,000	Still	41.3	-----	29.5	-----
2:20 P. M.	27.6	31	11,000	Still	34.9	-----	20.4	-----
3:20 P. M.	26.2	32	11,000	Still	34.4	-----	19.3	-----
4:20 P. M.	24.2	32	9,500	Still	35.7	-----	13.0	-----
5:20 P. M.	19.0	47	1,400	Still	28.5	117	10.2	112
Second Day								
9:15 A. M.	24.0	45	11,000	Light Breeze	29.2	-----	18.7	-----
10:45 A. M.	26.0	40	11,000	Still	21.6	82	14.4	79

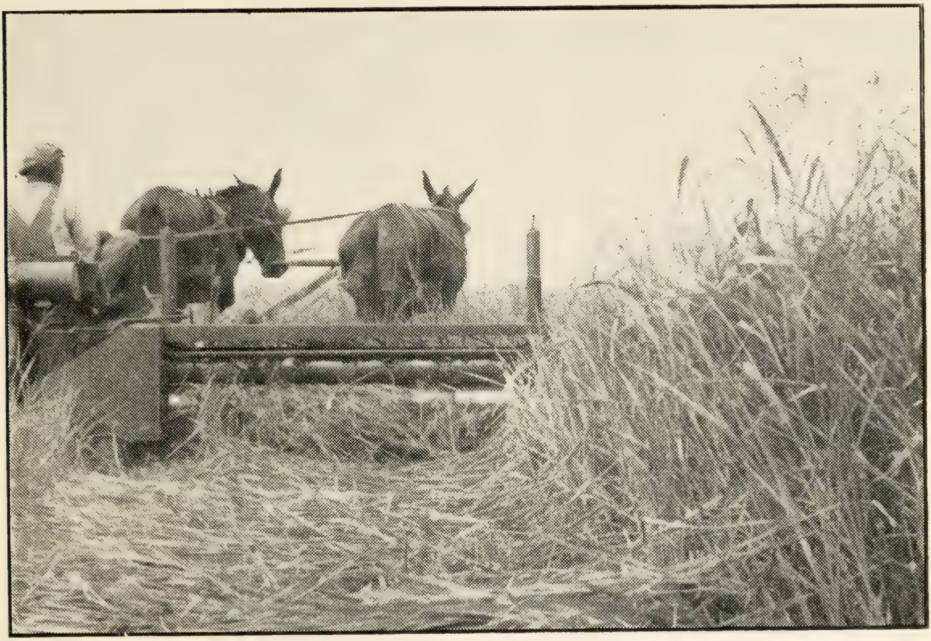


FIGURE 11—The John Bean Quick Hay Maker in operation in Johnson grass.

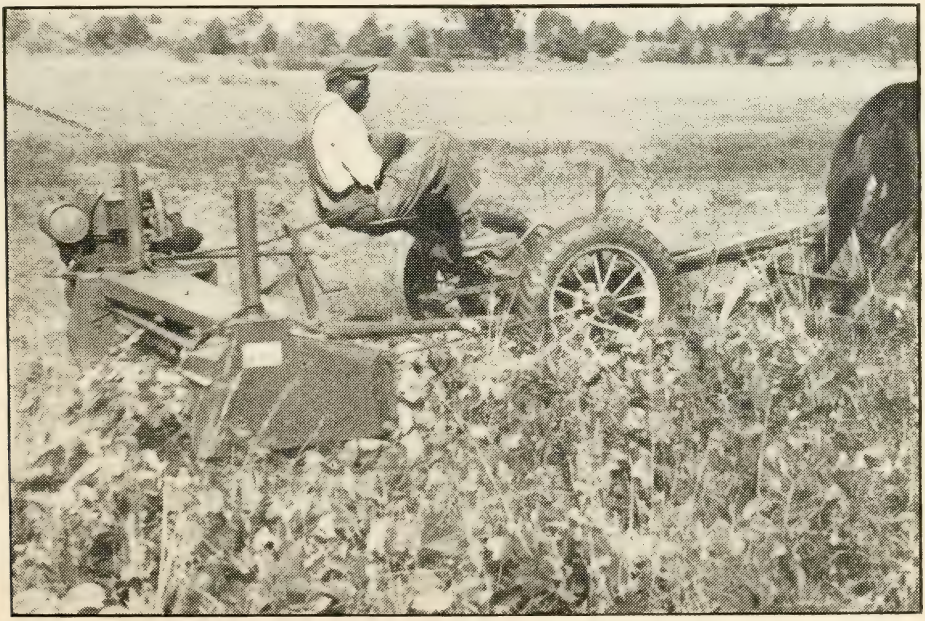


FIGURE 12—The John Bean Quick Hay Maker in operation in Kudzu.

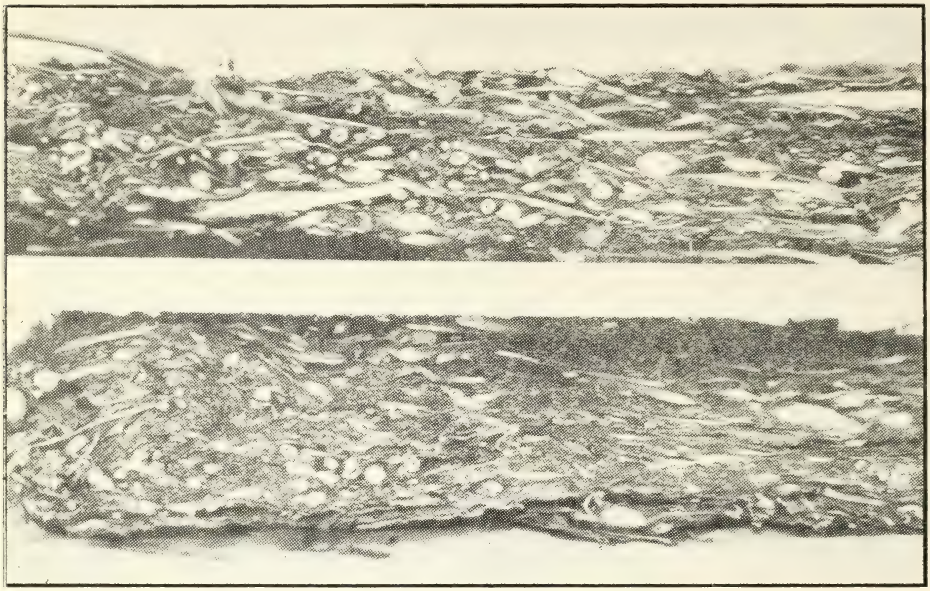


FIGURE 13A—Cross section view of crushed and uncrushed soybean hay.

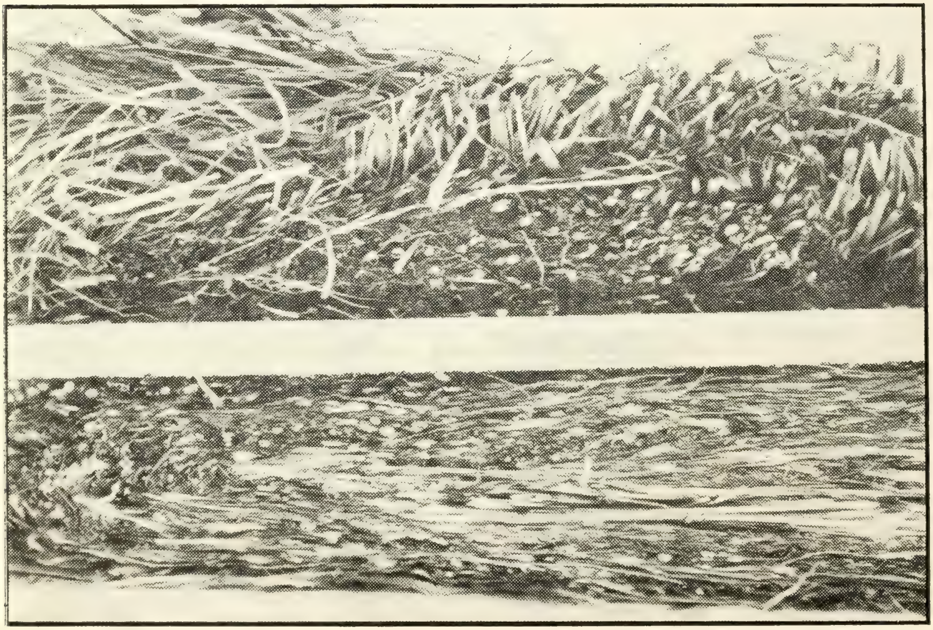


FIGURE 13-B—Cross section view of crushed and uncrushed Johnson grass hay.

cent and of the mowed vines 68 to 70 percent at this time.

Table 7 shows the moisture, protein, and carotene, in the fresh sweet potato vine. About two-fifths the dry weight of the tops consists of leaf-blades, the most valuable part of the vine. By raising the cutter bar 1½ inches above the bed, D. M. Warriner, president of the Warriner Starch Company, found that one could harvest 86.4% of the leaf-blades, 53% of the petioles and 6.9% of the stems (vines), which was equal to 1,311 pounds of leaf-blades, 460 pounds of petioles, and 112 pounds of stems (vines) per acre, dried to a moisture content of 10%.

It was found by using vine lifters on the mower, as shown in figure 15, which were made to fit the bed and thus lift the vines so that the cutter bar of the mower would get under them, that 85 per cent of the vines were cut. However, in crushing these vines much difficulty was encountered because the potatoes were planted on beds, allowing many of the vines, when cut, to fall into the middle. Since the pick-up attachment of the crusher will not pick the vines up out of the middle, many of the vines were not crushed.

This material would represent a feed of considerable value if it could be properly handled. The vines cause trouble when sweetpotatoes are harvested, and their removal for hay would facilitate harvesting the roots, would not reduce the yield of roots, and may one day prove a valuable by-product to the sweetpotato producer.

III. PRESERVING MAXIMUM FEED VALUE IN HAY

Leaves are richer than stems in many important constituents. Protein, ether extract, calcium and phosphorous are generally two or more times as abundant in leaves as in stems. The value of protein for animals is well known. The main part of the animal body is built of protein. The ether extract consists of fatty

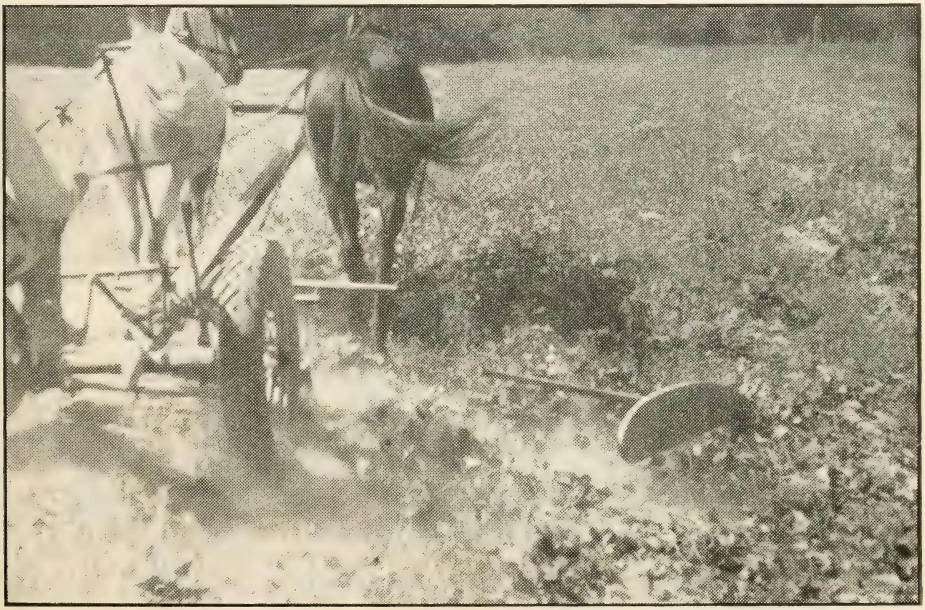


FIGURE 14—Mowing machine cutting sweetpotato vines for hay.

materials, which have numerous functions in the body. Calcium and phosphorous are necessary in making bone, teeth, as well as having other functions.

The following are some protein values for leaves (leaf-blades) and stems (rest) of some hay plants:

PROTEIN VALUES IN LEAVES AND STEMS

	Protein in leaves percent	Protein in stems percent
Johnson Grass	9.62	3.93
Soybeans	20.12	5.93
Kudzu	16 62	5.93
Sweetpotato vines	16.75	6.03

It will be noted that Johnson grass is poor in protein in both leaves and stems, when compared with the legumes. It is a wise practice to feed legume hay as it furnishes a supply of cheap protein.

Carotene (precursor of Vitamin A), Vitamin C, Vitamin D and Vitamin G are known to be more abundant in leaves than in stems. Carotene (beta carotene, mainly) is a yellow ether soluble pigment which is changed into Vitamin A in the bodies of animals. Without sufficient Vitamin A animals will be weak, sterile, may not grow well, and may die. Cattle seem to make enough Vitamin C for their needs under most conditions, although

TABLE 7—PROTEIN, CAROTENE AND MOISTURE IN DIFFERENT PARTS OF THE SWEETPOTATO VINE (TOP)

Plant Part	Percent Moisture	Per Cent of the Total Dry Weight of the Vine	Protein % Dry Wt.	Carotene p.p.m. Dry Wt.
Leaf-Blade	80.0	39.6	16.75	423
Petiole	90.3	27.1	4 56	48
Stem (Vine)	82.3	33.3	7.18	29
Entire Vine (Top)	85.1	100.0	10.37	180

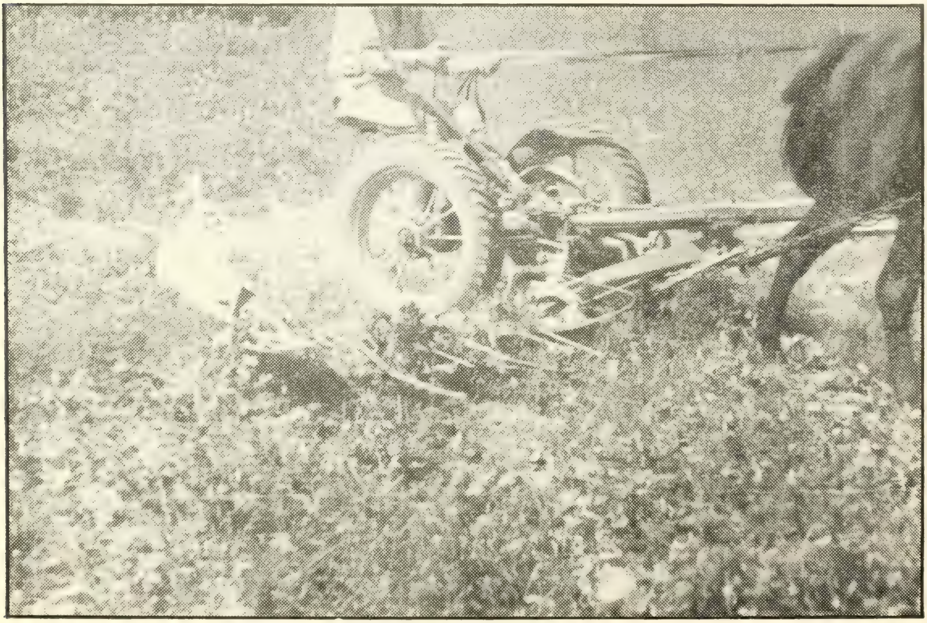


FIGURE 15—Experimental vine lifters found necessary in cutting sweetpotato vines.

there may be exceptions. Lack of Vitamin C results in scurvy in humans. Vitamin D is necessary for the proper formation of bones. Vitamin G aids in growth. Workers elsewhere have found Vitamin D to be six or seven times as abundant in leaves as in stems of alfalfa and Vitamin G to be four or five times as abundant in leaves as in stems.

Preserve Leaves

The distribution of carotene and Vitamin C was determined on Johnson grass, alfalfa, soybeans, sweet clover, kudzu and sweetpotato plants. Examples of the distribution of carotene and protein (table 7) and carotene and Vitamin C (table 8) are shown for sweetpotatoes and soybeans respectively. The leaves of the soybeans were ten times higher in carotene and four times higher in Vitamin C than any of the other parts of the plants tested The upper, greener portion of the stem was considerably richer in these vitamins than the lower, woody part. For the most part, 80 percent to 95 percent of the carotene in hay plants tested was present in the leaves, in the fresh state.

It is now pertinent to inquire how this proportion of carotene is affected in the curing of hay. Table 9 gives the values of carotene in leaves and stems of the Johnson grass, soybeans and kudzu. It is evident that although great losses occurred in the curing process, these losses were about the same for the leaves and stems. While still fresh 78 percent, 89 percent, 88 percent, and 92.4 percent of the carotene was present in the Johnson grass, large soybeans, small soybeans and kudzu leaves, respectively. The hays were mowed and cured in the swath until dry. Crushing affected the absolute values of carotene in leaf and stem but not the proportion of carotene lost.

The composition of plants varies with age This fact is true not only because young leaves and stems are richer in carotene than the same organs when mature, but also because the proportion of leaf to stem is greatest in young plants. Table 10, on carotene, is an illustration of the above statement. Protein, ether extract, minerals and vitamins decrease as the hay plants become mature.

The composition of a plant is affected by the conditions under which it is grown. In general, the more favorable the conditions for growth, the greater will be the carotene and other vitamins, protein and mineral values. Thus weather, fertility of the soil, and the disease markedly affect the composition of hay plants.

Preserve Carotene

Carotene is affected remarkably by various factors, and considerable destruction occurs in the curing process. Leaves

TABLE 8—CAROTENE AND VITAMIN C IN DIFFERENT PARTS OF THE SOYBEAN

Plant Part	Carotene p.p.m. Dry Wt.	Vitamin C % Dry Wt.
Leaf-Blade	908	0.73
Petiole	80	0.17
Upper Stem (Succulent)	90	0.18
Lower Stem (Woody)	18	0.06
Root	0	0.01

Plants were 2 feet tall and growing vigorously.

TABLE 9—CAROTENE IN LEAF-BLADES AND STEMS OF FRESH AND DRIED MOWED JOHNSON GRASS, SOYBEANS AND KUDZU.
VALUE AS P.P.M. DRY WEIGHT

	Johnson Grass		Soybean—Small		Soybeans—Large		Kudzu	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Leaf-Blades	400	61	400	123	408	115	254	140
Stems and Rest	38	6	32	10	20	5	24	10

left exposed to the sun lose their carotene more rapidly than those left in the shade. The mere process of drying the plants results in a considerable loss of carotene, especially if the drying is slow. The degree of destruction in the sun depends upon a number of factors, such as the light intensity, temperature, humidity, and the number of leaves which overlap. Plants grown under different conditions will lose a different proportion of their carotene upon drying, the more succulent seeming to lose carotene faster than the less succulent plants. Hay that has been wet by dew or rain is reduced thereby in carotene.

In a test, Johnson grass was raked five hours after being cut and compared with unraked hay after standing two days in the field. The shocked hay (interior of shock) had 65 p.p.m. carotene, and the surface of the shock had 25 p.p.m. and the hay in the swath contained 16 p.p.m. One can conclude from this test that the sun will lower the carotene content of hay wherever it is struck, but that shading, even by the outer layers of hay, reduces the destruction. Double windrowing alfalfa two hours after being cut would result in a product higher than if drying were allowed to proceed for a while longer in the swath. Thus, the hay would not only dry faster, as was pointed out earlier in this bulletin, but would also have a higher content of carotene.

Hasten Haymaking Process

Since light destroys carotene, the sooner hay can be removed from the field, the better. Crushed hay can be stored sooner than mowed hay, and, because of this, will always have more carotene. If crushed hay is left in the field as long as the mowed hay, there is little difference in the carotene values. Some of the factors which affect the destruction of carotene, such as light, temperature, and rain, also affect the quantity of ether extract and Vitamin C in hay.

In storage, carotene is still lost rather rapidly, the rate of loss depending on the temperature and other factors. Since carotene is lost from hay in storage, it is wise not to keep hay for more than a year.

The composition of plants varies with age. This fact is true not only because young leaves and stems are richer in carotene than the same organs when mature, but also because the proportion of leaf to stem is greatest in young plants. Table 10, on carotene, is an illustration of the above statement. Protein, ether extract, minerals and vitamins decrease as the hay plants become mature.

The composition of a plant is affected by the conditions under which it is grown. In general, the more favorable the conditions for growth, the greater will be the carotene and other vitamins, protein and mineral values. Thus weather, fertility of the soil, and disease markedly affect the composition of hay plants.

TABLE 10—CARROTENE AND RELATIVE WEIGHTS OF LEAF TO STEM IN SOYBEANS AT DIFFERENT STAGES OF GROWTH

	% Dry Wt. of Plant as Blade	P.P.M. Carotene In Plant (Dry Wt.)	P.P.M. Carotene Stem	P.P.M. Carotene Blades	% Total Carotene In Blades
Seedling (6" Stage)	82	541	156	625	94.8
14" Stage	64	453	85	660	93.2
Mature	27	125	20	408	89.0

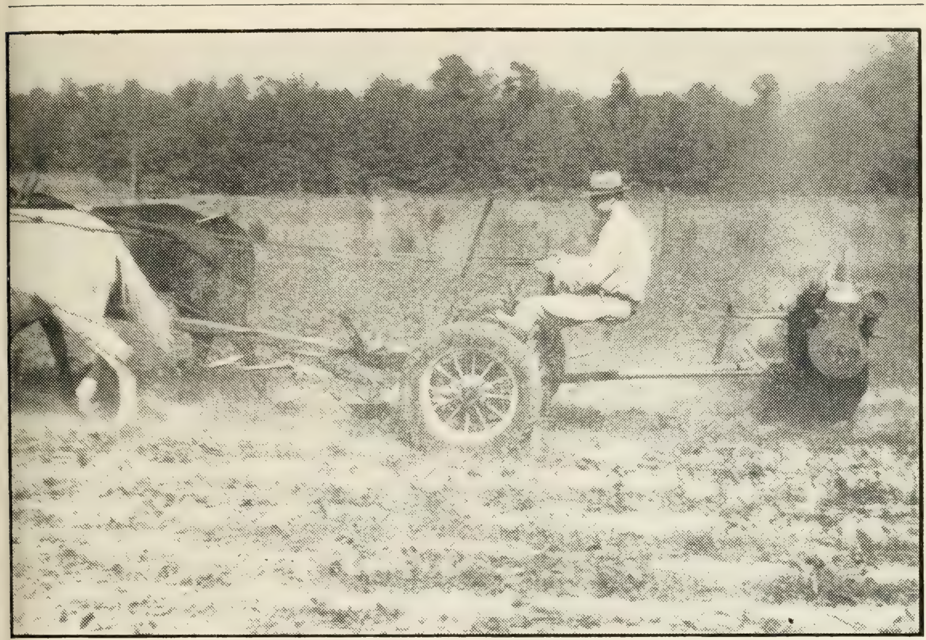
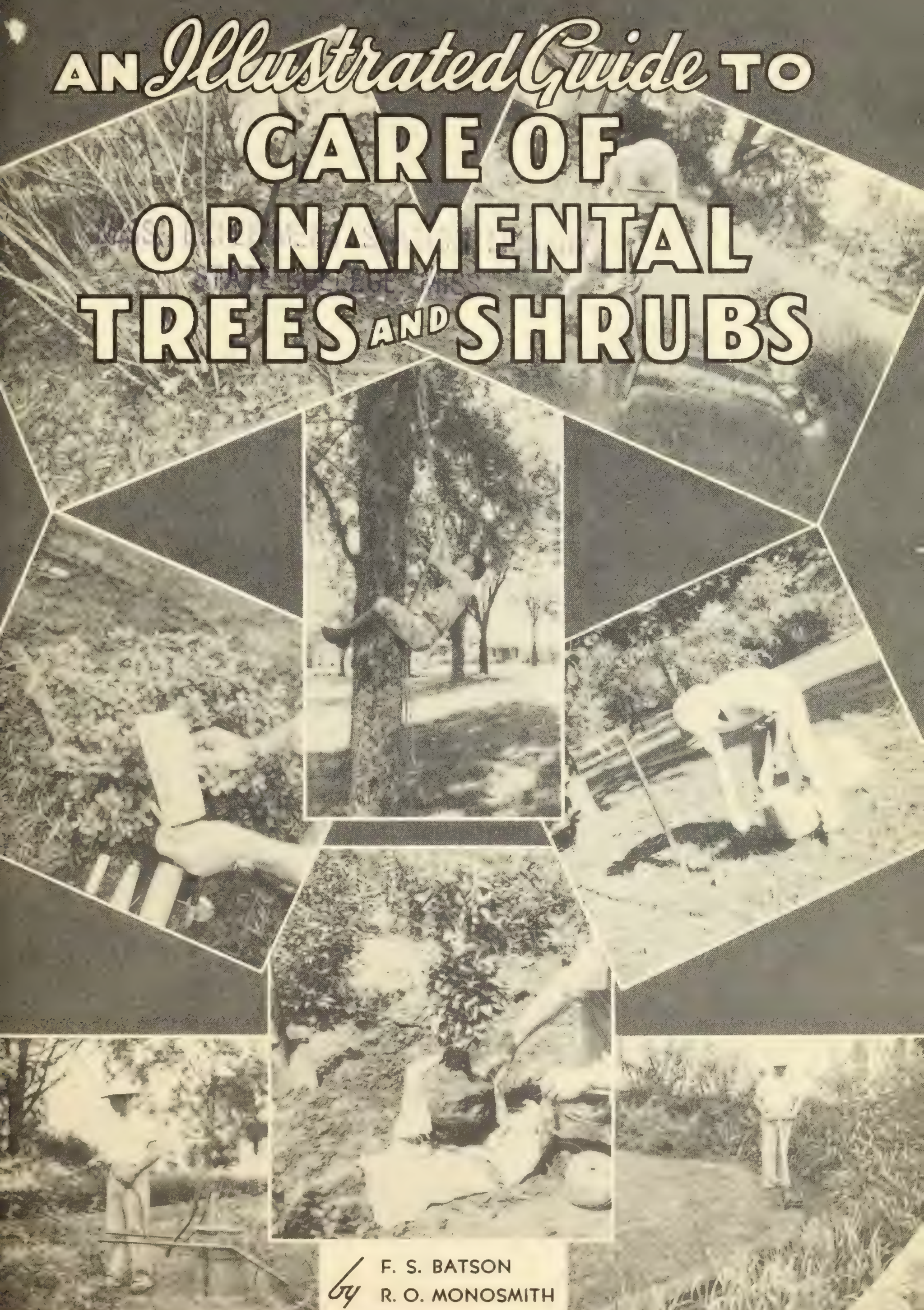


FIGURE 16—Mower with crushing machine attached, cutting and crushing sweetpotato vines for hay

AN *Illustrated Guide* TO CARE OF ORNAMENTAL TREES AND SHRUBS



by F. S. BATSON
R. O. MONOSMITH

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MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director STATE COLLEGE, MISSISSIPPI

AN ILLUSTRATED GUIDE

TO

CARE OF ORNAMENTAL TREES AND SHRUBS

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An Illustrated Guide to Care of Ornamental Trees and Shrubs

INTRODUCTION

Trees and shrubs respond readily to proper care. Plants having vigor, sturdy stems, rich green foliage and a profusion of flowers and fruits are essential parts of successful landscape gardening. Healthy plants can be obtained only when well adapted plants are selected, care is taken in transplanting, and correct maintenance is practiced. The landscape planting is a growing, constantly changing picture that requires some care each season such as fertilization, pruning, watering, cultivation, and mulching. Careful planning preceding actual planting will greatly simplify much of this seasonal maintenance.

Planning of plantings should include the selection of adapted plants with special reference to hardiness, light, soil and moisture requirement. The selection of the planting site should be considered from the standpoint of both planting design and growth of the plants. Proper plant spacing is absolutely essential for the continued success of the planting; a crowded planting is never attractive. Careful thought should be given in the selection of plants, to the height they will grow. Pruning plants severely several times each season is not a satisfactory solution of the problem created when a large, rapid growing shrub is placed under a low window or some other location where a low growing plant is needed.

Transplanting is the moving of a plant bodily from one location to another. This subjects plants to a rather severe shock even when proper precautions are taken. There are several factors to consider if a high percentage of transplanted plants are to live. Some of these factors which apply to both trees and shrubs are: time of year, size of plant to move, careful digging, transporting, soil preparation, planting, pruning, and watering. Trees require still further treatment when transplanted, such as guying and trunk protection.

Maintenance or perpetual care is necessary for final success in growing ornamental plants. Landscape plantings reflect neglect in magnified proportions.

A properly planned, planted and maintained planting on the grounds of every home and public building in Mississippi would reflect credit upon our entire population. This illustrated guide is offered to aid Mississippians in attaining this goal.

ORNAMENTAL PLANTS AND THEIR REQUIREMENTS

There are over 150 different species of woody plants commonly used in ornamental plantings in Mississippi. This list includes both evergreen and deciduous trees, shrubs and vines. In this group of plants great variations in plant requirements will be found. Certain groups of plants have specific temperature, soil, light, and moisture requirements. Plants will not grow successfully unless these requirements are provided.

HARDINESS

The climate in this state is generally mild. This permits the use of many semi-hardy plants in the southern half of the state. The desirability of using these tender plants in north Mississippi is doubtful. This applies to such plants as cape jasmine, camellia, Indian azaleas, ardisia, cleyera, feijoa, oleander, Japanese privet, sweet olive, pittosporum, and flowering pomegranate. Substitutes can be found for these among the hardy plants. Occasionally a severe winter occurs with temperature as low as zero. Plants usually listed as hardy are injured by these temperatures. Included are such plants as: cherry-laurels, firethorns, laurestinus, nandina, glossy abelia, photinias, glossy privet; nevertheless, these plants are recommended for use throughout Mississippi because these temperatures are unusual and because each of these plants will grow back to desired size quickly after being frozen to the ground.

SOIL

Most ornamental plants thrive best in sandy or clay loam soil containing liberal quantities of organic matter such as decayed leaves, peat moss, or well rotted manure. Trees need a deep, friable sub-soil. A hard-pan near the surface usually results in the early death of trees. Soil reaction influences all plant growth. With the exception of azaleas, camellias and their plant relatives in the ericaceous family most plants have a wide range of adaptability, growing in a moderately sweet or acid soil with equal success. Azaleas and camellias require an acid soil in which to grow. This subject of soil reaction is discussed in more detail elsewhere in this bulletin.

LIGHT

Of the ornamental plants grown in Mississippi a small percentage grow well in shady places, many like full sun, and others grow best in partial shade. Shade loving plants should be selected for shady places. Some of the plants that grow well in the shade are: boxwood, Japanese holly, nandina, mahonia, euonymus, winter honeysuckle, camellias, azaleas, elder, pearlbush, spiraeas, goldenbell, sweetshrub, snowball, hydrangea, wild azalea (pink honeysuckle), yaupon holly, vinca and English ivy. No plants grow well when tree root competition is severe. Avoid planting under trees if possible.

MOISTURE

Thorough drainage of shrub beds and tree locations is absolutely necessary. Soggy soil and standing water at the base of the plant will cause the roots to rot very quickly.

When necessary drain soil around plants by using tile, elevated planting beds, or gravel base.

SPACING OF PLANTS

"Plant thick and thin quick" is not a good rule for general use. Thick plantings give quick effects, but unless the other part of the rule is applied and thinning is done soon after planting this effect is short lived. The best rule to follow is to place plants in permanent positions at first planting with adequate room to grow to mature size without crowding.

The drawing below shows correct spacing for large and small trees, very large, large, medium and low shrubs, as well as four types of evergreens. Large trees would include besides oak and pecan, the hackberry, pine, elm, maple, magnolia, and sycamore. Small trees include willow, dogwood, redbud, mimosa, flowering crabs, soapberry and holly. Examples of the size of plant referred to in the shrub spacing are: very large shrub, crepe myrtle; large shrub, althea; medium shrub, vanhout spirea; low shrub, thunberg spirea.

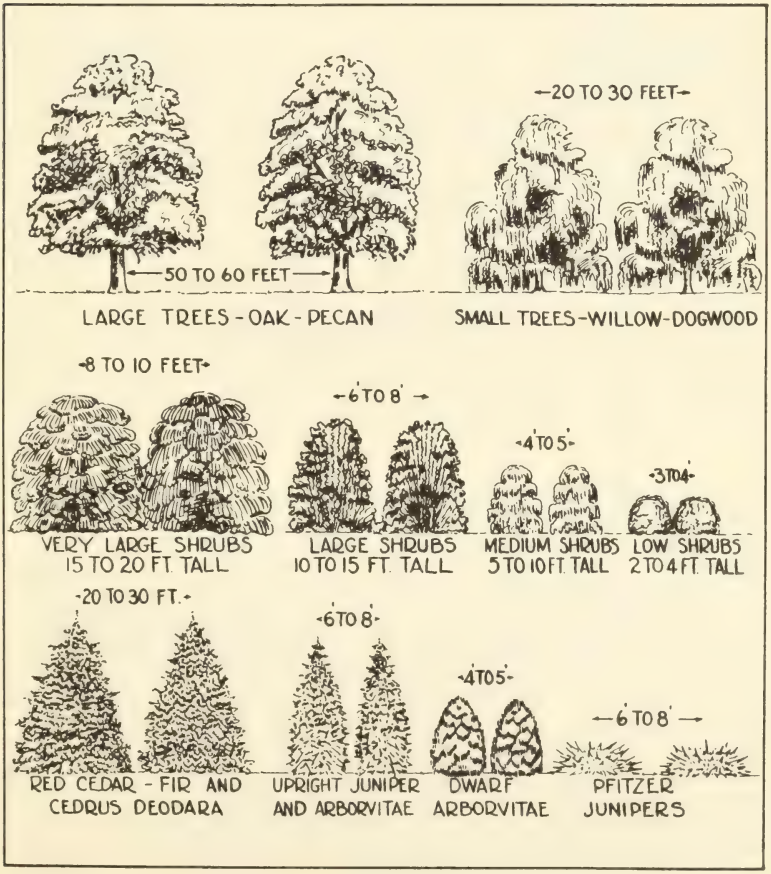

50 TO 60 FEET
LARGE TREES - OAK - PECAN
20 TO 30 FEET
SMALL TREES - WILLOW - DOGWOOD
8 TO 10 FEET
VERY LARGE SHRUBS 15 TO 20 FT. TALL
6' TO 8'
LARGE SHRUBS 10 TO 15 FT. TALL
4' TO 5'
MEDIUM SHRUBS 5 TO 10 FT. TALL
3' TO 4'
LOW SHRUBS 2 TO 4 FT. TALL
20 TO 30 FT.
RED CEDAR - FIR AND CEDRUS DEODARA
6' TO 8'
UPRIGHT JUNIPER AND ARBORVITAE
4' TO 5'
DWARF ARBORVITAE
6' TO 8'
PFITZER JUNIPERS

Figure 1—Spacing of plants

SELECTION OF TREES

Nursery grown trees are more desirable than trees collected from the woods because nursery grown plants have a more compact root system and the tops are usually trained to a desirable shape by nurserymen. If trees are selected from the woods care should be exercised in the selection of the plant to be moved. The plants selected should be vigorous and well shaped. A fibrous, compact root system is more likely to be found on plants growing in a fertile soil. Any tree to be dug should be in the open so that it may be dug without interference from roots of surrounding plants.

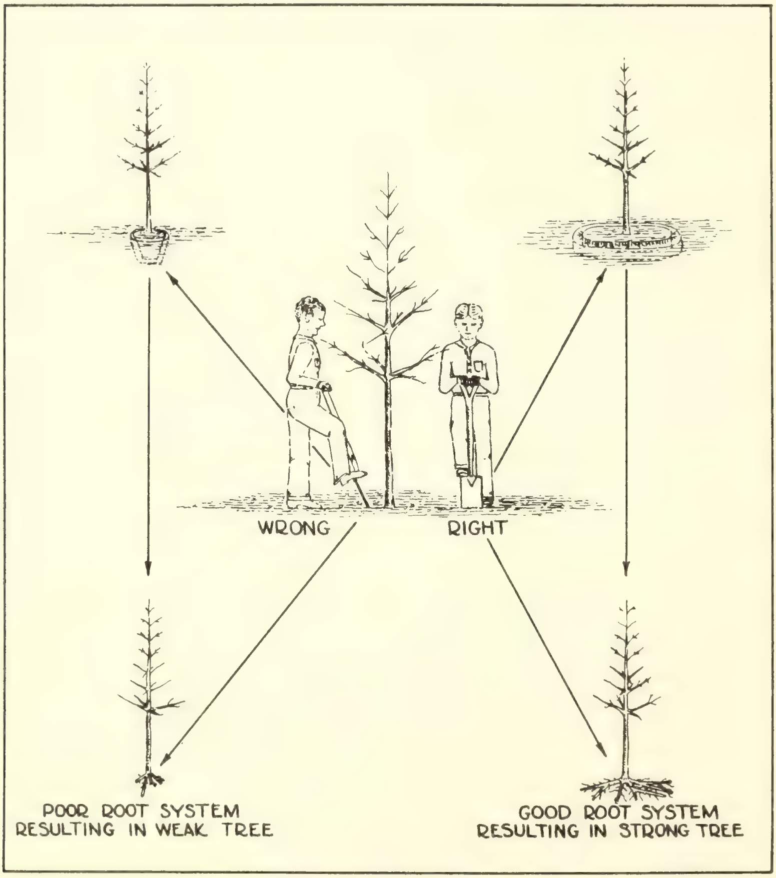

WRONG
RIGHT
POOR ROOT SYSTEM RESULTING IN WEAK TREE
GOOD ROOT SYSTEM RESULTING IN STRONG TREE

Figure 2—Digging a tree

Careful digging is important in transplanting trees. Care should be taken to get all roots possible in uninjured conditions. This can be done most successfully when the soil is loosened and main roots located before being cut. In the diagram "Digging a Tree" the right and wrong way is shown. This method is particularly desirable in moving oaks, dogwood and other trees difficult to move.

TRANSPLANTING TREES AND SHRUBS

TREES

Trees may be transplanted any time during the dormant season, which is ordinarily from November to March or April. Trees can be moved earlier or later if great care is taken, but such a practice is hazardous and not recommended except for experienced tree movers.

Small trees, ranging in size from 6 to 12 feet tall and having a diameter of 1 to 3 inches at the ground level, are recommended for successful transplanting. The amateur is often inclined to transplant relatively large trees, expecting to produce a large tree in a short time. This may be done if the tree is dug with a good root system and a ball of earth, but it requires skill and equipment in digging and transporting.

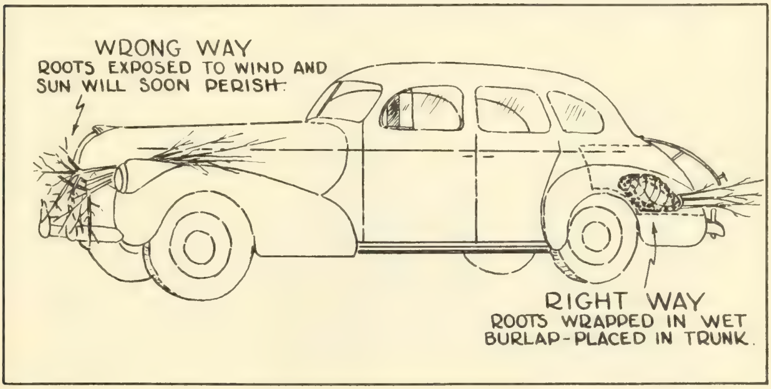

WRONG WAY
ROOTS EXPOSED TO WIND AND SUN WILL SOON PERISH
RIGHT WAY
ROOTS WRAPPED IN WET BURLAP-PLACED IN TRUNK.

Figure 3—Right and wrong way to carry plants

The roots of plants being transplanted need protection from wind and sun. Do not expose the roots to drying influence of wind on the front of the car as shown in the diagram above, or to the hot sun's rays along the side of the road as shown in the photograph below. Wrap the roots in wet burlap, sphagnum moss or other material to protect them as much as possible until plants are set in a new location.

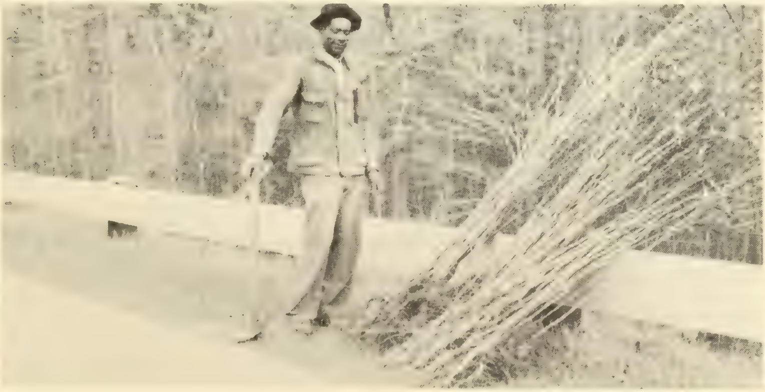


Figure 4

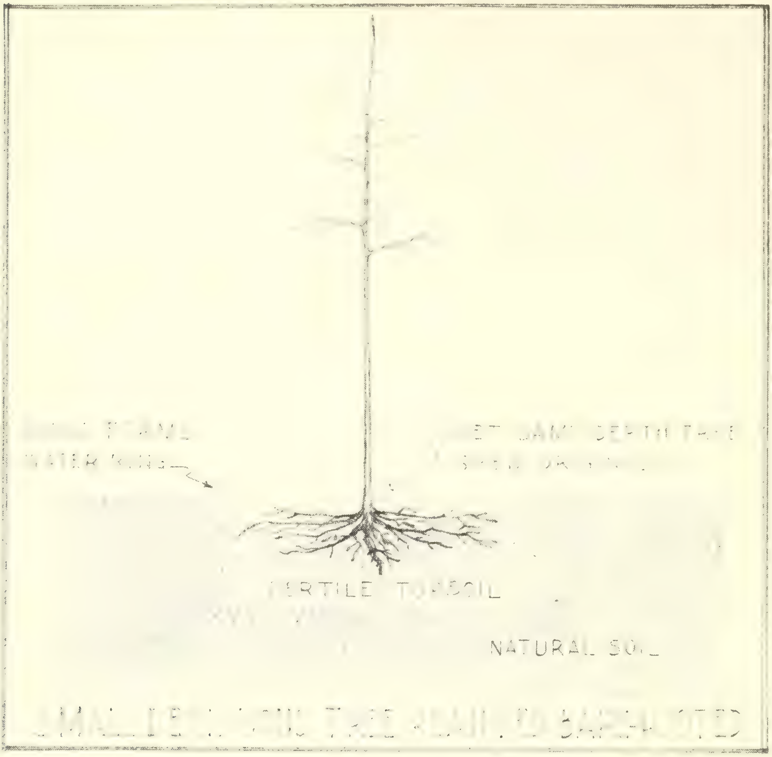


Figure 5

PLANTING TREES

The sooner trees can be replanted after digging, the greater their chance of survival. If trees cannot be planted as soon as they reach their destination, they should be "heeled in" by placing them upright, close together in a trench dug in moist loamy soil, and the dirt packed around the roots.

In planting a tree dig the hole large enough so the roots can be spread to a natural position without cramping them. If the trees are being planted in poor soil an effort should be made to secure good soil to place about the roots, discarding the soil removed from the hole.

Trees should be planted at the same depth they were growing originally. The soil ring on the tree trunks will guide the careful observer in this. Dig the hole several inches deeper than the roots will be placed in order that fertile top soil can be placed under the roots. Before planting the tree any bruised root tips should be removed with pruning shears or knife. The roots should be spread out in the hole so as to be evenly distributed. Well-rotted manure can be mixed with the soil to be placed around the roots, but no fresh manure should come in contact with the roots. Place the soil around the roots in layers of several inches and pack each layer firmly. Adequate soil should be worked under the crown.

Water should be poured in the hole after it has been three-fourths filled with soil. When this water has soaked in, fill the hole with soil to the level of the surrounding ground and make a water basin by providing a circular ridge placed 2 or 3 feet from the trunk of the tree. Fill this basin with water and allow to soak into the soil. If settling occurs refill the depression to original level.

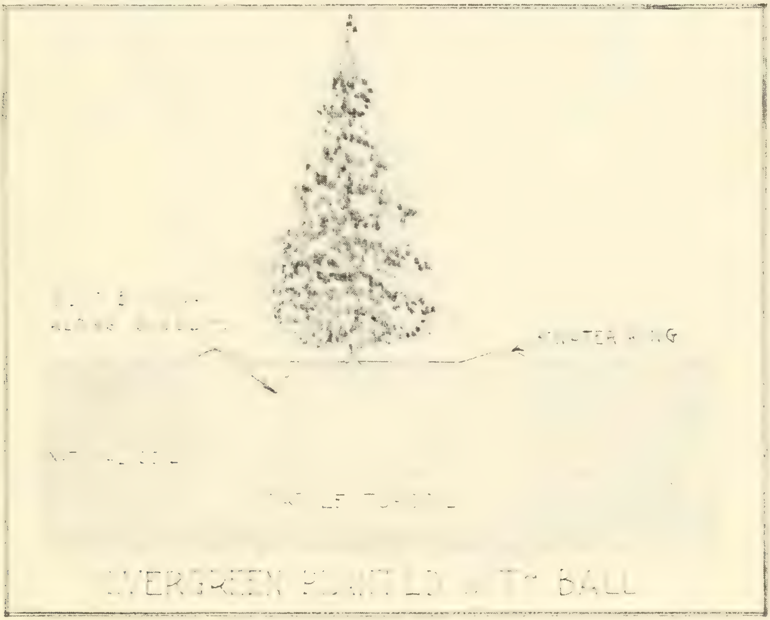


Figure 6

Evergreens should be dug with a ball of earth around the roots. Trees growing in silt or clay soil can be dug with a ball much easier than trees in a sandy soil. The size of the ball of earth to dig with the tree varies somewhat depending on the species of plant and the type of soil. In most instances this ball should be about 1 foot in diameter for each inch diameter of the tree trunk. Ordinarily trees one-half to 1 inch trunk diameter require a depth of ball of about 9 to 12 inches. Trees having 2 to 3 inch trunk diameter should be dug to a depth of about 12 to 18 inches. See page 14 figures 12 and 13 for illustration of burlapping.

Most deciduous trees dug during the dormant season do not require a ball of earth in transplanting; however, a few species such as dogwoods, magnolias, and oaks are more likely to live when dug with a ball of earth.

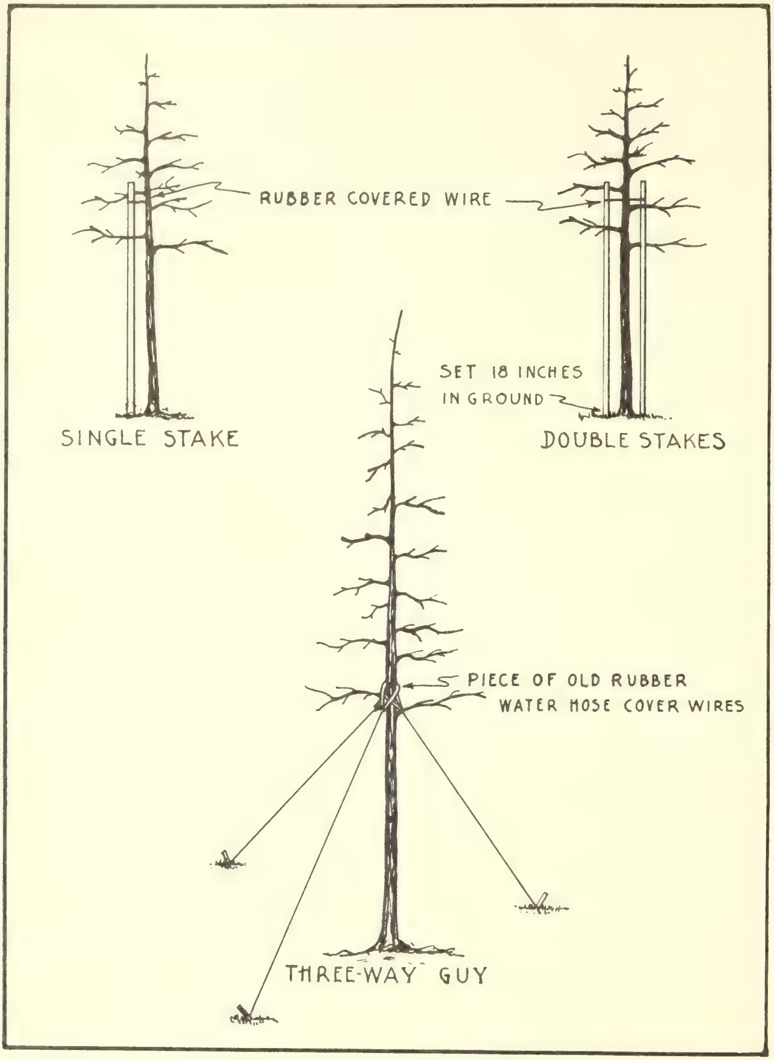

RUBBER COVERED WIRE
SET 18 INCHES IN GROUND
SINGLE STAKE
DOUBLE STAKES
PIECE OF OLD RUBBER WATER HOSE COVER WIRES
THREE-WAY GUY

Figure 7—Guying trees

GUYING TREES

Newly transplanted trees eight feet tall and taller need support until the new roots can become firmly established. Three methods are suggested in figure 7. The single stake is sufficient for smaller trees whereas the double stake or three way wire guy is recommended for larger sizes. In each method a soft surface such as rubber should protect the tree trunk from the supporting wires. A section of discarded water hose, slipped over the wire is satisfactory. Some sway is to be expected even with guyed trees and care should be taken to keep the soil packed around the trunk.

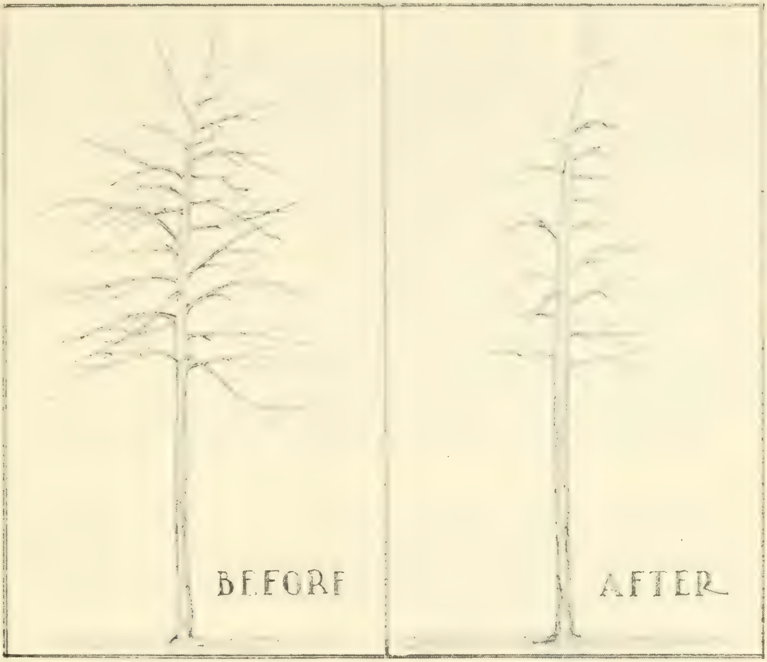


Figure 8—Correct method of pruning for transplanting

PRUNING TRANSPLANTED TREES

The reduction of root system caused in digging a tree for transplanting necessitates a comparable reduction in top. One-half to two-thirds of the branches of a transplanted tree should be pruned out as shown in figure 8. A common mistake in transplanting trees is that of moving a tree that is too large, then cutting the top by the “de-horning” method as shown in figure 9. A very low percentage of these severely pruned, oversized trees live, and those that do are usually stunted and have poorly shaped crowns.

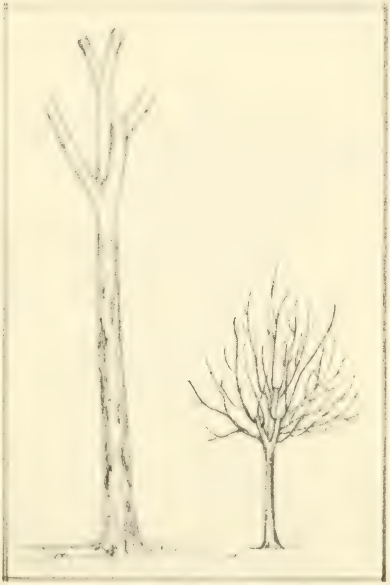


Figure 9—Common mistakes in pruning for transplanting

CARE OF TRANSPLANTED TREES

Subsequent care of trees after moving includes adequate watering, regular cultivation, or mulching. New roots can form only when sufficient moisture is present in the soil. Severe wilting of the leaves will occur if the soil becomes dry, and the plant will probably die. Water the tree with a slow stream of water that flows slowly enough to allow all the water to soak into the ground. Light sprinklings of water do more harm than good. Keep the ground cultivated within 3 or 4 feet of the tree or mulch this area with 3 or 4 inches of leaves, straw or peat moss, because weeds take needed moisture from the soil to the detriment of the plant.

Wrapping the trunk of the tree with heavy prepared paper or burlap to protect it from insect injury and sunscald is needed in after-transplanting tree care. Figure 10 shows how the material is applied to minimize injury from the flatheaded borer. This paper or burlap should be placed on the tree in February or early March and allowed to stay on the tree throughout the summer. If not torn it will prevent bettles from laying eggs in the trunk of the tree. Trees weakened by transplanting are particularly susceptible to such injury.

When pecans and other trees difficult to move are transplanted the roots are sometimes treated with root promoting dusts made of indolebutyric acid and talc to stimulate root growth. Such treatment is in the experimental stage at present, but it shows promise and may be used more extensively in the future.

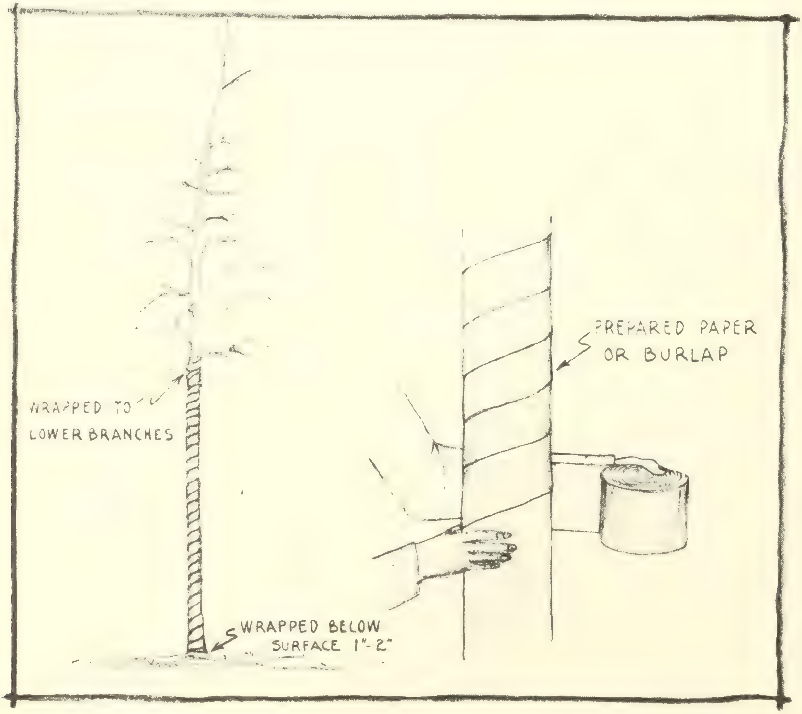


Figure 10—Tree trunk wrapped to prevent sunscald and insect injury

TRANSPLANTING SHRUBS

There are two general types of shrubs used in landscape plantings — deciduous, those that shed their leaves in winter; and evergreens, those that retain their foliage all year. The deciduous shrubs are usually easier to transplant than evergreen species, requiring less care in handling. Deciduous shrubs are usually moved barerooted, and practically all evergreens shrubs are moved with a ball of earth.

The most satisfactory time to transplant shrubs is during the months of November and December. Second choice as to time of transplanting is January, February and March. Shrubs can be moved in April, May and early June, but more care is necessary in providing large balls of earth on both deciduous and evergreen shrubs, watering frequently, and shading plants in the heat of the day. Even with this additional care a high death rate can be expected ordinarily in plants transplanted after growth has started, especially in May and June.

In digging both nursery and native shrubs care should be taken to secure an adequate root system. Figure 11 tells a graphic story. Root strength determines the quality of a plant. Notice the two plants in the picture. They are the same age; both are young 3 year old spireas. The root system of the plant on the left is vigorous and well branched while the root system of the other is weak and half dead. The plant with the poor root system was growing in the same row in the nursery as the good root system, but in a poorly drained place on the row. The lower roots had been killed by poor drainage. It takes a good root system to make a healthy long lived plant. Get root strength in your plants.

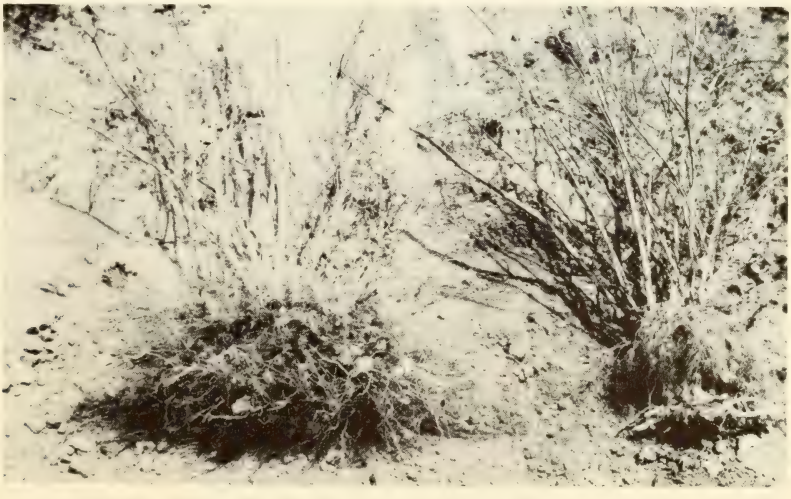


Figure 11—Shrub with good root system on left; poor root system on right

DIGGING EVERGREENS

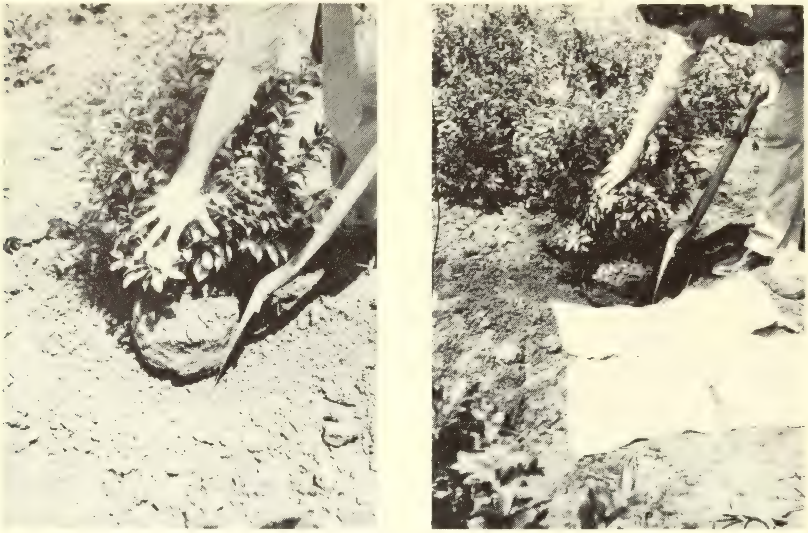


Figure 12

An evergreen shrub dug with a ball of earth ready to be placed on burlap that has been cut to receive the ball.

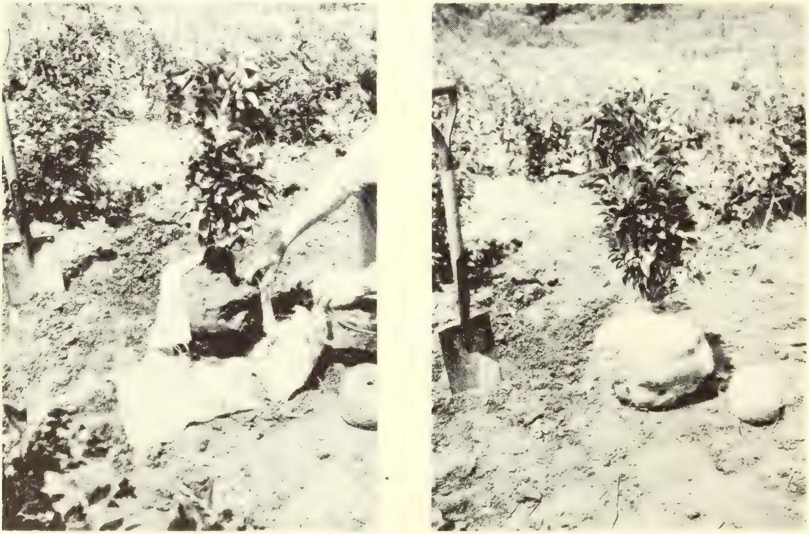


Figure 13

After the branches have been tied with a cord to facilitate handling, the ball of soil is wrapped with burlap. The completed job shows the cord used to make a neat package and keep the ball of earth from breaking apart. When the plant is set in the hole of the planting bed the cord and burlap should be removed or thoroughly slit sides before filling around the ball with soil.

PREPARATION OF PLANTING BED FOR SHRUBS

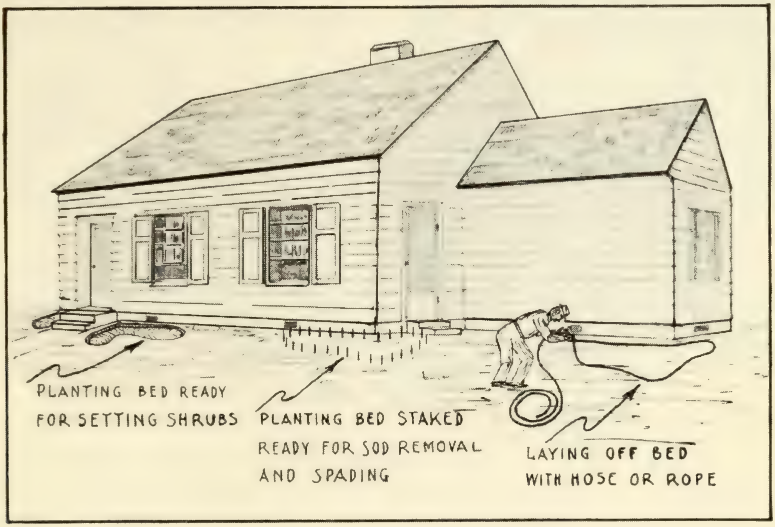
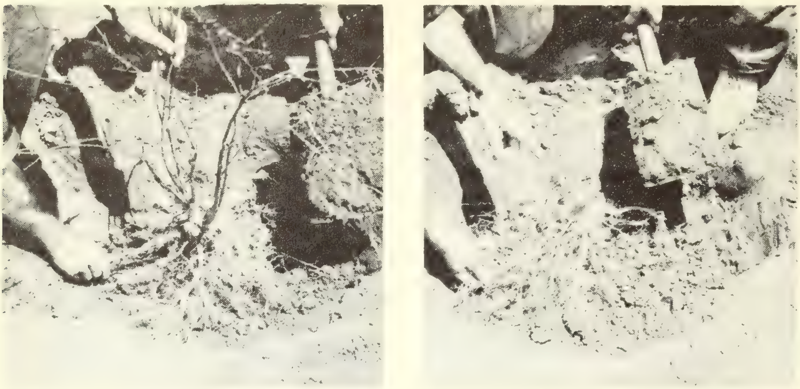


Figure 14—Steps in preparation of planting bed for shrubs

Shrubs should be planted in well prepared planting beds, not small pocket holes that have been hollowed out of the sod. Planting beds serve several purposes. First, they provide the necessary soil conditions for healthy shrub growth since the soil can be fertilized and thoroughly spaded when the beds are made. Secondly, the neat, trim outlines of these beds add to the attractive appearance of the planting. Thirdly, the vertical edge of the bed affords a means of keeping the lawn grass out of the shrub planting.

Planting beds can be designed most successfully on paper. A plan properly applied as shown in figure 14 creates attractive flowing curves and proper proportions. In the absence of a plan, however, graceful curves can be had in planting bed outlines by following the suggestions given in figure 14, designing the beds on the ground with a hose or heavy rope. Small temporary stakes are set along the inside of the hose after it has been finally placed, near enough together to give the outline of the curves. Using this line of stakes as a guide, the outline of the bed is cut in the turf or ground and all sod removed within the area. The soil should then be fertilized with 1 or 2 inches of thoroughly rotted manure and 10 pounds of superphosphate to each 100 square feet of bed and the area spaded to a depth of 10 inches. It will be necessary to remove every third shovelful of earth from the bed to prevent excessive heaping of the soil in the bed. Rake the surface until smooth, edge the bed by throwing dirt toward the middle away from sharp edge in sod, and the planting bed is ready to receive the shrubs.



A **Figure 15—Planting a native shrub** B

PLANTING SHRUBS:

Dig a hole that will accommodate all the roots without crowding, loosening the soil to a depth of 12 to 18 inches. Set the plant at same depth it was growing in nursery or woods, spreading the roots in all directions as shown in figure 15A. If the top is poorly developed a more attractive shrub will be formed, especially in deciduous native shrubs if the top is pruned back to the ground as shown in figure 15B. Place the soil over the roots, slowly tamping each shovelful to firm the soil about the roots. Fill the hole level full of soil and make a water ring as shown in figure 16. Water thoroughly. A loose mulch of soil, leaves, or straw placed over the shrub bed will help hold the moisture in the soil.

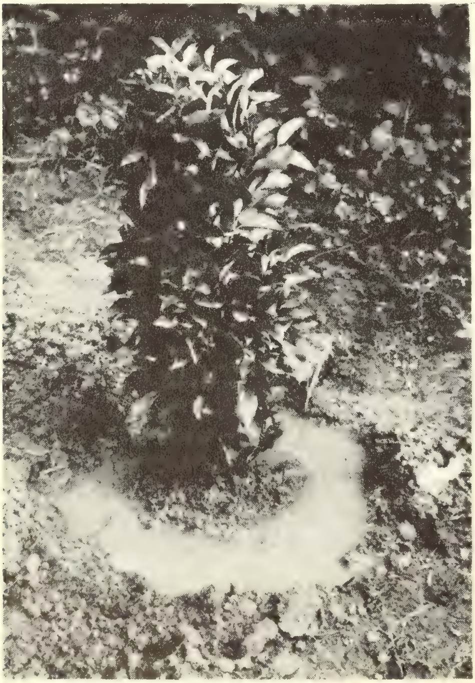


Figure 16—Watering a shrub

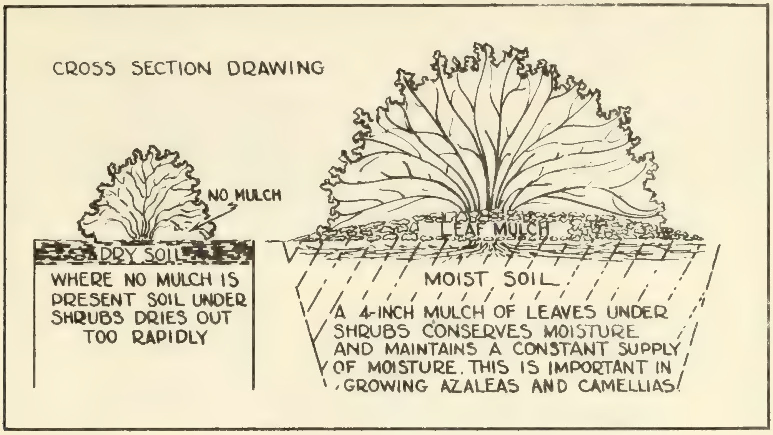

CROSS SECTION DRAWING
NO MULCH
DRY SOIL
WHERE NO MULCH IS PRESENT SOIL UNDER SHRUBS DRIES OUT TOO RAPIDLY
LEAF MULCH
MOIST SOIL
A 4-INCH MULCH OF LEAVES UNDER SHRUBS CONSERVES MOISTURE AND MAINTAINS A CONSTANT SUPPLY OF MOISTURE. THIS IS IMPORTANT IN GROWING AZALEAS AND CAMELLIAS

Figure 17—Growth increase due to mulching shrubs

CULTIVATION AND MULCHING SHRUBS

The subjects of cultivation and mulching are discussed together since both practices keep down weeds, conserve soil moisture, and improve soil texture. One and 2 year old shrub beds should be cultivated after each rain, or in the case of prolonged dry spells the beds should be hoed once a month to kill weeds and keep a 1-inch dust mulch on the surface of the soil. Well established shrub beds should be mulched and not cultivated. Weeds in such beds can be pulled by hand.

Mulch is the term applied to a loose layer of one of several materials on the surface of the soil. This material might be leaves, leaf mold, peat moss, clean straw, or cotton seed hulls. Pine straw, which is available in many parts of the state, is very desirable for mulching shrub beds. A 3- or 4-inch layer of this material on shrub beds will keep down weeds, conserve moisture, and improve the soil when spaded into the bed after decaying. Mulching is a necessary practice in growing azaleas, camellias, boxwood and other shallow rooted plants that require constant moisture in the soil. It is also beneficial when used on many other species of plants.

Figure 18—Loose soil mulch

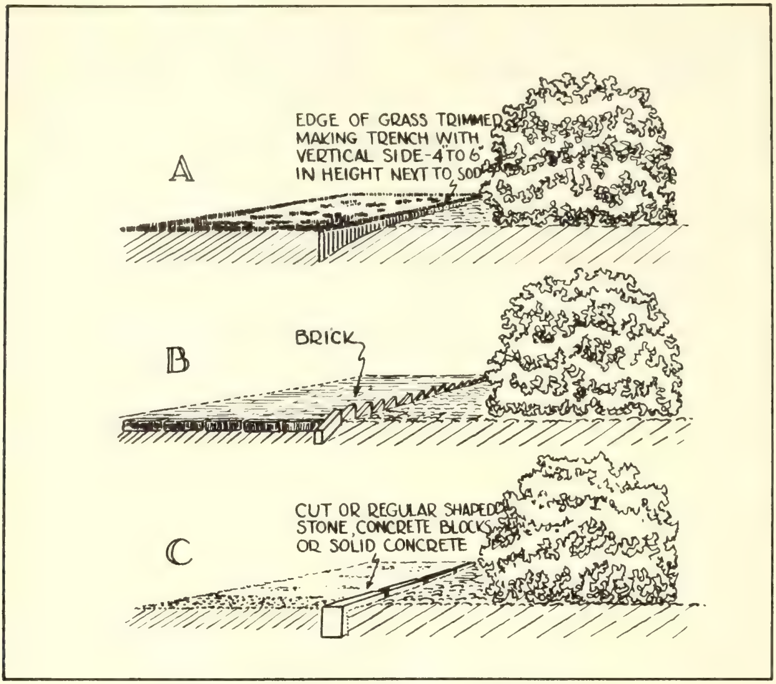

A
EDGE OF GRASS TRIMMED MAKING TRENCH WITH VERTICAL SIDE-4" TO 6" IN HEIGHT NEXT TO SOD
B
BRICK
C
CUT OR REGULAR SHAPED STONE, CONCRETE BLOCKS OR SOLID CONCRETE

Figure 19—How to edge shrub beds

EDGING SHRUB BEDS

Neat edges are necessary if the shrub bed is to contribute to the beauty of a landscape planting. These edges can be defined in three ways, as illustrated above in figure 19. The trench (A) with vertical side next to sod is least expensive and highly recommended. It is maintained as shown in photographs below. Bricks (B) placed on edge at 45 degree angle make a very neat edging in small gardens or around foundation plantings. Regular shaped stones (C), concrete blocks, brick, or a 3-inch solid concrete curb make satisfactory edging materials. Do not use rough, jagged, irregular stones as they create anything but a tidy appearance.

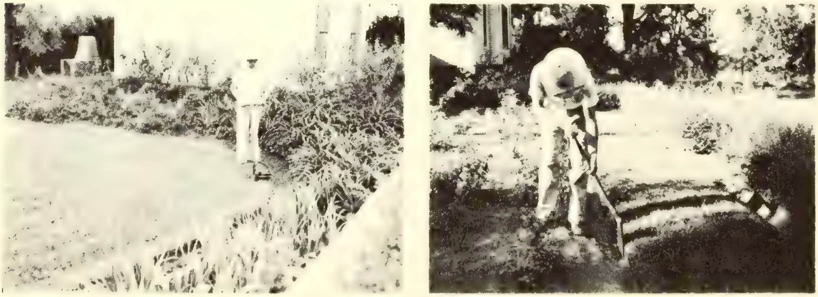


Figure 20—Shrub beds neatly edged adds greatly to the attractiveness of planting

FERTILIZATION OF TREES AND SHRUBS

Facts concerning nutrient requirements of plants comprise a complicated science, but feeding ornamental trees and shrubs can be a relatively simple practice that any gardener will find easy. The most efficient use of commercial fertilizer requires careful consideration of soil types and soil analyses. Satisfactory results can be secured, however, by making simple soil reaction tests, using a few standard fertilizer mixtures and carefully observing plant response.

Manure is an excellent fertilizer and soil conditioner, but is no longer considered the only fertilizer material to be used. Commercial fertilizers can be used effectively with no damage to the plants after a simple working knowledge of their effect on plants has been obtained.

Ten elements have been considered for many years to be essential to plant growth. Of these, only nitrogen, phosphorus and potassium are present in so-called complete fertilizers, and are thought to be the ones most often limiting plant growth. Carbon, hydrogen, and oxygen are present normally in the air in sufficient quantities for normal plant growth. Calcium, iron, magnesium, and sulphur may be deficient in some soils under which conditions they must be added to fertilizer mixtures or applied separately as salt or salts of the needed element. Recent experiments show that some minor elements as boron, manganese and possibly copper and zinc are necessary in extremely small quantities for proper development of certain plants.

The effects of all elements on plant growth should be more generally known by gardeners.

Nitrogen stimulates leaf and stem growth and is the element that gives the "push" to plants. Nitrogen should be added to the soil at periods when the plant is in active growth. Overdoses may cause burning and this valuable plant nutrient should be handled with care. Chemical sources of nitrogen are nitrate of soda, ammonium sulphate, mixed fertilizers such as 4-8-4. In mixed fertilizer formulae the numbers indicate, in the order given, the percentages of nitrogen, phosphorus and potash. Nitrogen is also present in such organic fertilizers as cotton seed meal and animal manures.

Phosphorus keeps a check on the stimulation when undue amounts of nitrogen are applied. It hastens maturity, stimulates flower and seed production and aids in root development. Since it penetrates the soil slowly when applied to the surface it should, when possible, be incorporated thoroughly with the soil at the time of bed preparation, or if applied later it should be worked into the soil as much as possible. Usual sources are superphosphate (acid phosphate), basic slag, and mixed fertilizers.

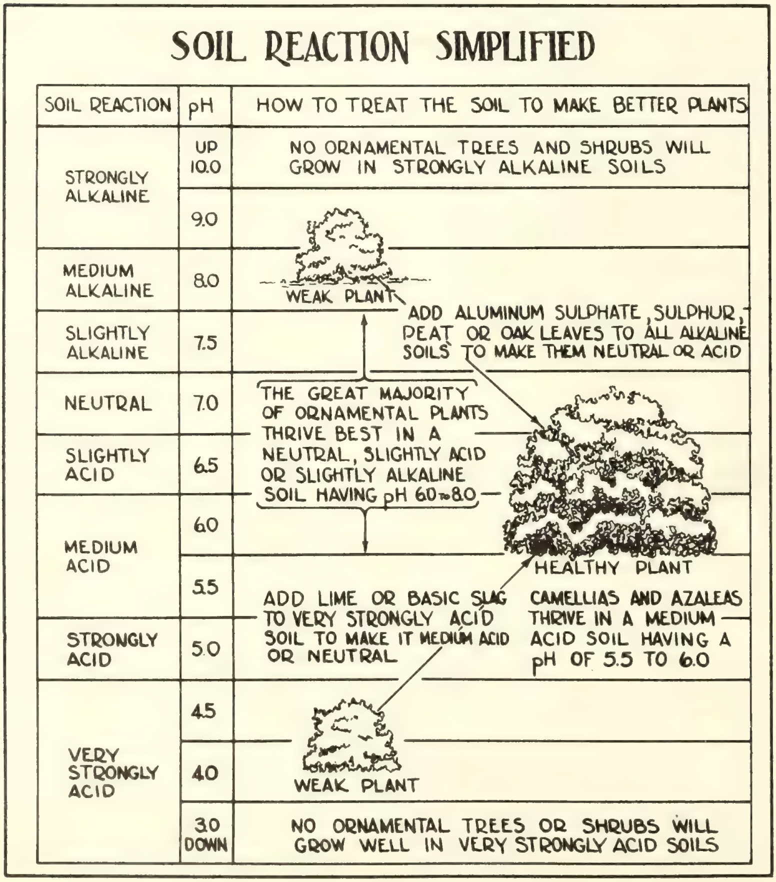
Potassium or potash is a general plant conditioner. It aids plants in overcoming brittleness, hastens maturity and intensifies flower color. It also aids in disease resistance and seed production. Sources are muriate of potash, sulphate of potash, wood ashes, and mixed fertilizers.

Calcium influences soil reaction, liberates nitrogen, phosphorus and potassium in the soil, aids bacterial growth, and performs many functions in the plant such as building healthy cell walls, and increasing absorptive capacity of roots.

Magnesium functions in seed formation, cell growth, and chlorophyll formation (green coloring in leaf).

Sulphur is a constituent of plant protein.

Iron is an important part of chlorophyll.



SOIL REACTION SIMPLIFIED

SOIL REACTION	pH	HOW TO TREAT THE SOIL TO MAKE BETTER PLANTS
STRONGLY ALKALINE	UP 10.0	NO ORNAMENTAL TREES AND SHRUBS WILL GROW IN STRONGLY ALKALINE SOILS
	9.0	
MEDIUM ALKALINE	8.0	
SLIGHTLY ALKALINE	7.5	
NEUTRAL	7.0	
SLIGHTLY ACID	6.5	
MEDIUM ACID	6.0	
	5.5	
STRONGLY ACID	5.0	
VERY STRONGLY ACID	4.5	
	4.0	
	3.0 DOWN	NO ORNAMENTAL TREES OR SHRUBS WILL GROW WELL IN VERY STRONGLY ACID SOILS

ADD ALUMINUM SULPHATE, SULPHUR, PEAT OR OAK LEAVES TO ALL ALKALINE SOILS TO MAKE THEM NEUTRAL OR ACID

THE GREAT MAJORITY OF ORNAMENTAL PLANTS THRIVE BEST IN A NEUTRAL, SLIGHTLY ACID OR SLIGHTLY ALKALINE SOIL HAVING pH 6.0 to 8.0

ADD LIME OR BASIC SLAG TO VERY STRONGLY ACID SOIL TO MAKE IT MEDIUM ACID OR NEUTRAL

CAMELLIAS AND AZALEAS THRIVE IN A MEDIUM ACID SOIL HAVING A pH OF 5.5 TO 6.0

Figure 21—Soil reaction simplified

SOIL TESTING

Soils can be tested by a quick test color method to determine the relative amounts of total nitrogen, phosphorus, potash, iron, magnesium, manganese and calcium in the soil. This method of soil testing is easily learned and the test is easy to make, but more equipment is required than the average home gardener would wish to buy, and the results secured in these tests can be interpreted only by someone with considerable experience. Therefore, it is suggested that the amateur be guided by general fertilizer recommendations given in this bulletin, page 23, by a keen observation of plant growth and of plant response to fertilizer applications, and by making tests for soil reaction.

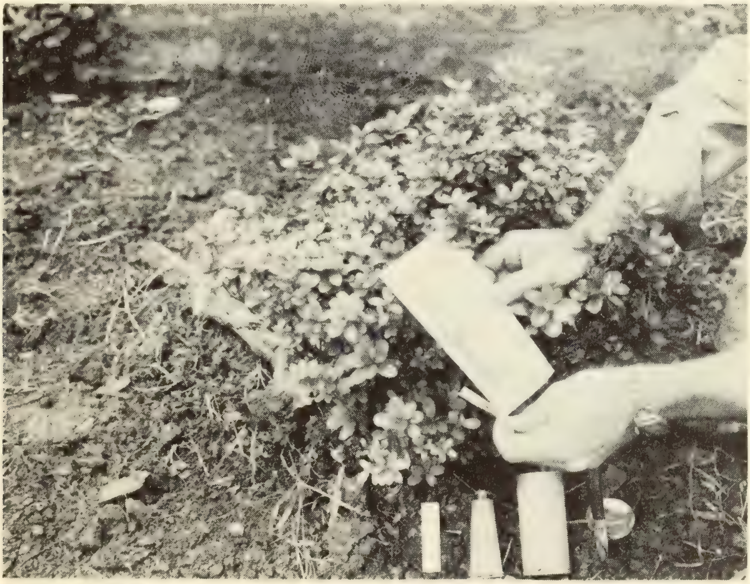


Figure 22—Testing soil reaction for Azaleas

Soil reaction (acidity or alkalinity) can be tested using a simple inexpensive set such as the one shown in figure 22. The results of this test can guide one in changing the soil reaction if necessary by the addition of lime or sulphur, aluminum sulphate or peat to fit the needs of certain plants. Soil reaction effects the availability of the nutrients in the soil. While the reaction of the soil is not the only factor influencing the availability of nutrients it is an important one. Considering the elements as a group, the striking fact is that a medium acid reaction is necessary for adequate availability of all the essential elements except calcium and magnesium. Acidity is expressed in terms of pH values. In the pH reaction scale pH 7.0 represents a neutral reaction. Any pH number from 0 to 7 indicates an acid reaction, with decreasing acidity as the number increases. Any pH value from 7 to 14 indicates an alkaline soil, with increasing alkalinity as the size of the number increases. Available data indicates that a reaction of the soil between pH 6.0 and 6.5 is the most favorable to maintain in a great majority of ornamental plants. Medium acid soils are necessary for azaleas and camellias. A few woody ornamental plants grow more successfully in a neutral or slightly alkaline soil. Among this group are redbud, deutzia, winter honeysuckle, mockorange, lilacs and common snowball.

Soil reaction determines the color of hydrangea blooms. In an acid soil hydrangea flowers are blue, while in a neutral or slightly alkaline soil the flowers are pink. The color of flowers to be produced in any bearing season is determined by the soil reaction.

The soil reaction can be changed from acid to alkaline by adding lime. It can be changed from alkaline to acid by adding sulphur, aluminum sulphate or peat. (See page 24 for method of changing alkaline soils to acid reactions.

When necessary, ground limestone can be added to the soil to increase alkalinity as indicated in the following table:

Present pH of Soil	**Pounds of Agricultural Ground Limestone Needed for Each 100 sq. ft. to raise:**					
	Sandy Loam Soils		**Silt Loam Soils**		**Silty-Clay Loam Soils**	
	To pH 6.0	To pH 6.5	To pH 6.0	To pH 6.5	To pH 6.0	To pH 6.5
6.0	None	23	None	41	None	58
5.5	23	46	41	83	55	115
5.0	46	69	83	124	115	173
4.8	55	78	97	138	138	196

***Key to Nutrient Deficiences:**

The following abbreviated key is a guide to aid home gardeners in determining what plant nutrients are lacking in the soil when plants show decreased growth that is general on the whole plant or localized when insects and diseases are absent.

---

* "Key To Nutrient Deficiences" from Nursery Notes by L. C. Chadwick, Ohio State University, Columbus, Ohio.

1. Effects general on whole plant or localized on older, lower leaves.

    2. Effects usually general on whole plant

        3. Foliage light green. Growth stunted, stalks slender, leaves small, lower ones lighter yellow than upper. Soil needs **nitrogen**

        3. Foliage dark green. Delayed growth. Lower leaves sometimes yellow between viens but more often show a tendency to develop purplish coloration. Leaves dropping early. Soil needs **phosphorus**

    2. Effects usually local on older, lower leaves

        4. Lower leaves mottled. Yellowing begins at margins and continues toward center. Margins of leaf later become brown, curve under, and older leaves drop. Soil needs **potash.**

        4. Lower leaves yellow but usually show no spotting until late stages. Yellowing begins at leaf tip and progresses downward and inward. Leaf margins may curve upward or develop a puckering effect. Seldom seen in soils testing pH 5.5 or above. Soil needs **magnesium.**

1. Effects localized on new leaves

    5. Terminal buds remaining alive

        6. Leaves yellow between the veins, veins remain green

            7. Leaf spots usually absent. Soil needs **iron**

            7. Leaf spots usually present. Soil needs **manganese**

        6. Leaves light green, veins lighter than other parts of leaf. Soil needs **Sulphur**

    5. Terminal bud usually dies

            8. Break down at tip and margin of young leaves. Young leaves often definitely hooked at tip. Soil needs **calcium**

            8. Break down at base of young leaves. Stems and petiole brittle. Soil needs **boron**

How to fertilize shrubs.

There is a great deal of variation in soil requirements. Thorough preparation of soil and the incorporation of well rotted manure and superphosphate, 10 pounds per 100 sq. ft. are desirable before planting. Top dress established shrub beds with 2 to 5 pounds of a fertilizer having an analysis of 6-8-8 or 4-12-4, each spring. Use 1 to 2 pounds of a mixed fertilizer around each specimen shrub when planted singly. Further application can be made, based on plant response or soil tests.

How to fertilize evergreens.

Incorporate well-rotted manure or peat moss at time soil is prepared. Well-rotted manure or peat used as a mulch during winter may be incorporated into the soil each spring.

Narrowleaf evergreens. Small plants. — Tankage or cottonseed meal, 5 to 6 lbs. per 100 sq. ft. of bed area each spring.

Larger plants — 6-8-8 or 4-12-4, 2 to 4 lbs. per 100 sq. ft. of bed areas each spring. Hoe or "water-in" the fertilizer. Specimen plants of shrubby type one-half to 1 pound per plant twice a year, early spring and about June 15. Specimen trees, 2 to 2½ lbs. per each inch in diameter of the trunk.

Broadleaf evergreens — Many plants of this type require an acid soil. Materials which tend to make soil neutral or alkaline should not be used.

1. Supply liberal quantities of humus by incorporation, and adding as a mulch, acid peat moss or half rotted oak leaves. In poor soils where additional fertilization is necessary, add well rotted manure and cottonseed meal. Cottonseed meal applied at the rate of 5 pounds to 100 square feet is excellent for small plants. For large plants use a 4-12-4 fertilizer in which cottonseed meal is used to supply one-half to three-fourths of the nitrogen. Apply at the rate of 2 to 4 pounds to 100 square feet of bed area. "Water-in" the fertilizer. For large specimen plants follow the same rate of 2 to 4 pounds to each 100 square feet of bed area. "Water-in" the fertilizer.

2. To maintain an acid reaction (pH 4.5 to 6.5) add finely ground sulphur or aluminum sulphate. The following approximate amounts of sulphur for each 100 square feet will be necessary to increase the acidity in a silt loam soil from:

	Sulphur pounds		Sulphur pounds
pH 8.0 to 7.0	2.0	pH 7.0 to 6.5	1.5
8.0 to 6.5	3.0	7.0 to 6.0	2.0
8.0 to 6.0	4.0	7.0 to 5.5	3.5
8.0 to 5.5	5.5	7.0 to 5.0	5.0
8.0 to 5.0	7.0	6.5 to 6.0	1.5
7.5 to 7.0	1.75	6.5 to 5.5	2.5
7.5 to 6.5	2.0	6.5 to 5.0	4.0
7.5 to 5.5	5.0	6.0 to 5.0	3.0
7.5 to 5.0	6.5	5.5 to 5.0	1.5

3. Maintain a cool, moist soil by providing partial shade and mulches.

4. Provide some protection in the winter from hard drying winds and excessive sun exposure. Mulch heavily.

5. Roots of most broadleaf evergreen plants are located very near the surface of the soil and should not be disturbed. Mulch rather than cultivate. Keep roots moist and cool.

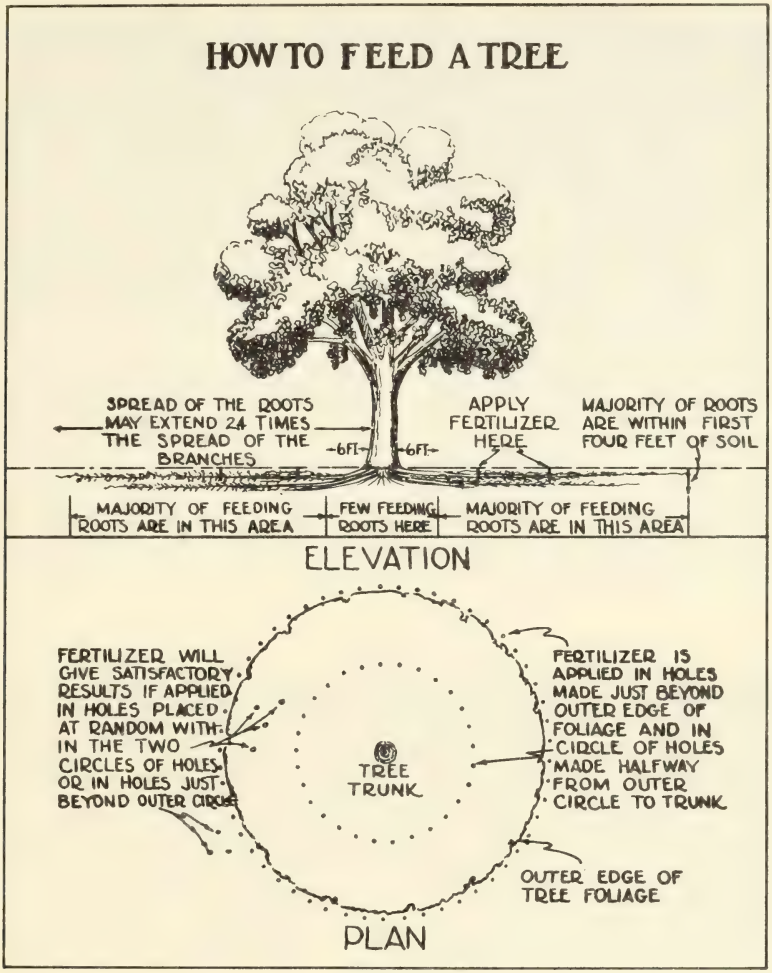

HOW TO FEED A TREE
SPREAD OF THE ROOTS MAY EXTEND 24 TIMES THE SPREAD OF THE BRANCHES
6FT
6FT
APPLY FERTILIZER HERE
MAJORITY OF ROOTS ARE WITHIN FIRST FOUR FEET OF SOIL
MAJORITY OF FEEDING ROOTS ARE IN THIS AREA
FEW FEEDING ROOTS HERE
MAJORITY OF FEEDING ROOTS ARE IN THIS AREA
ELEVATION
FERTILIZER WILL GIVE SATISFACTORY RESULTS IF APPLIED IN HOLES PLACED AT RANDOM WITHIN THE TWO CIRCLES OF HOLES OR IN HOLES JUST BEYOND OUTER CIRCLE
TREE TRUNK
FERTILIZER IS APPLIED IN HOLES MADE JUST BEYOND OUTER EDGE OF FOLIAGE AND IN CIRCLE OF HOLES MADE HALFWAY FROM OUTER CIRCLE TO TRUNK
OUTER EDGE OF TREE FOLIAGE
PLAN

Figure 23

How to Fertilize Trees. Trees have a wide variation in soil requirements. Thorough preparation of the soil and the incorporation of well-rotted manure or peat moss and superphosphate (5 pounds per inch in diameter of tree trunk) are desirable before the planting of most trees. Proper aeration and adequate moisture are required for growth. Fertilizer applications are recommended as follows:

Time — Fall (Oct. 15 to Nov. 15) preferred, although spring satisfactory.

Kind of fertilizer — 10-6-4, ammo-phos (11-48-0) or 6-8-4. The complete fertilizer 10-6-4 is considered best, but at present is not generally available in Mississippi.

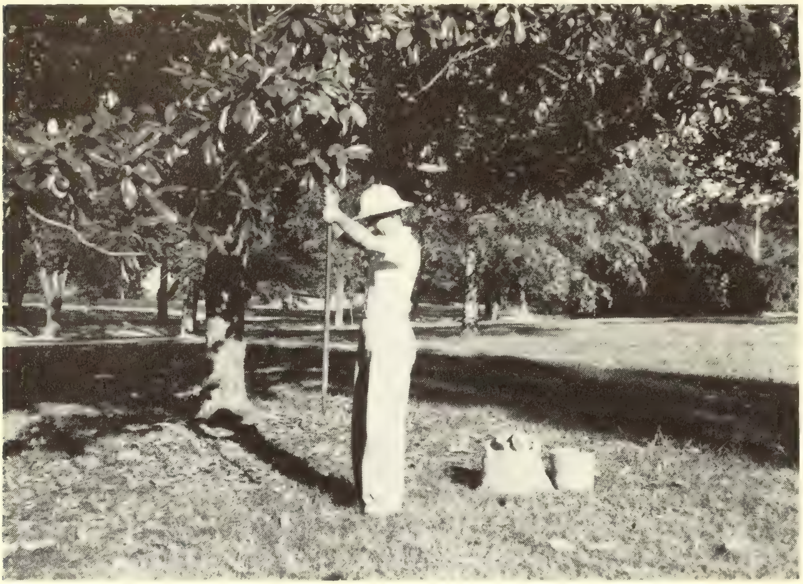


Figure 24—Punching hole with iron bar to receive fertilizer—bar raised

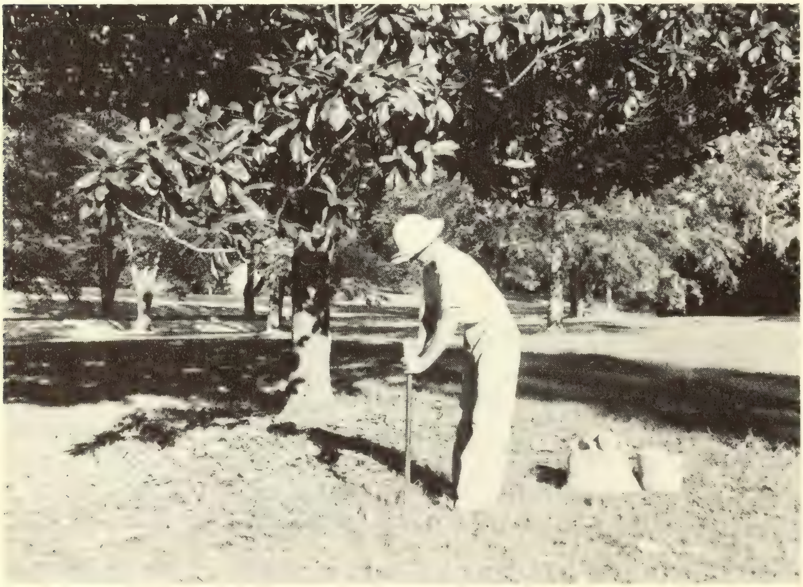


Figure 25—Punching hole with iron bar to receive fertilizer—bar inserted

Rate of application

Small trees, less than 6 inches in diameter, approximately 4 lbs. 6-8-4 for each inch in diameter of tree trunk.

Large trees, more than 6 inches in diameter, approximately 8 lbs. 6-8-4 per inch in diameter of tree trunk. Nitrogen fertilizers such as nitrate of soda or ammonium sulphate when applied alone give good results when nitrogen is the only element lacking in soil. Apply 1 pound of either of these materials to each inch of diameter of tree on trees under 6 inches in trunk diameter and 2 lbs. for each inch diameter of tree greater than 6 inches in trunk diameter.

Frequency of application

One to three years, depending on kind of tree and growth responses.

Method of application

Broadcast — Small trees that have soil worked around them. Hoe or "water in" the fertilizer.

Punch-bar — Apply in holes distributed evenly beneath the extremities of the branches and over an area just beyond the spread of the branches. Approximately 10 holes for each one inch in diameter of the tree trunk. Make holes 15 to 18 inches deep with a soil auger or crowbar. Place fertilizer in the holes, finish filling them with soil and cap with sod.

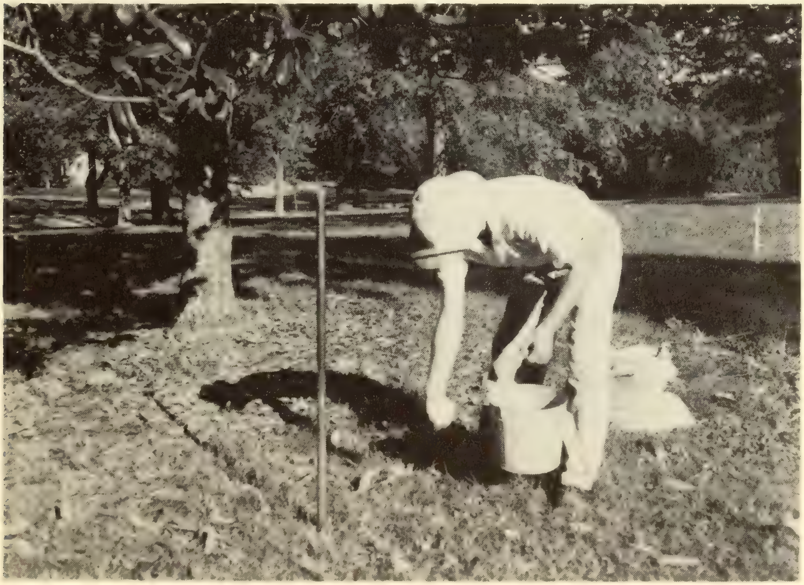


Figure 26—Applying fertilizer

PRUNING TREES

Pruning, which may be done at any time of the year, is one of the most important phases of tree care. When the tree is small, pruning is needed to start the branching habit in order to produce a well shaped crown and eliminate the possibility of later developing bad crotches. Older vigorous growing trees often produce an extremely dense crown which causes branches to die or become weakened due to a lack of sunlight. Thinning the branches in a dense crown allows more sunlight to penetrate thus producing more vigorous healthy branches. Dead branches allowed to remain in a tree are unsightly, sometimes dangerous to lives and property, and often injurious to the tree. Large dead branches which are allowed to remain in non-resinous trees soon begin to decay· The rot fungi spread into the trunk of the tree often resulting in large cavities that weaken it. If dead branches are removed before rot begins, the health of the tree may be preserved. The lower branches of trees along streets or near buildings may be removed so as to provide free circulation of air, open views, and allow greater freedom for traffic along streets. Trees planted on the lawn are often more attractive and useful if the lower branches are not removed and the branches are allowed to grow to the ground. Old slow growing trees may be rejuvenated by heading back to induce new growth. It should be remembered that every species of tree has its own characteristic habit of growth and it is usually

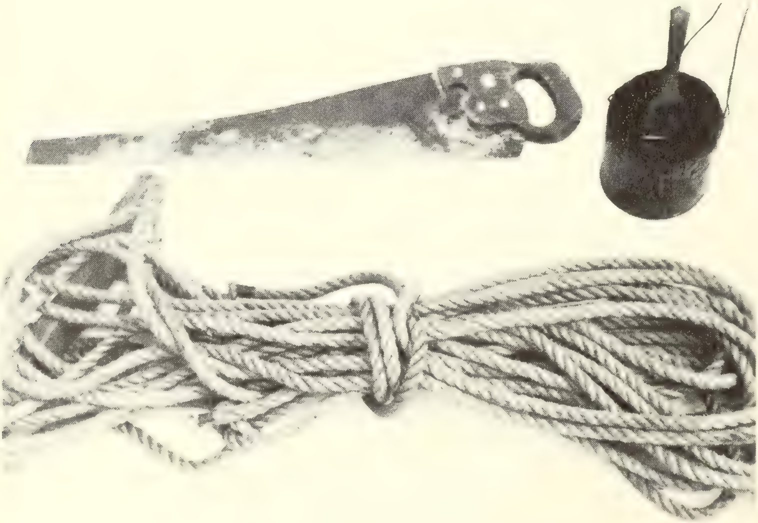


Figure 27

Tools and materials needed in pruning trees: safety rope, pruning saw, can of tree dressing and paint brush.

best not to try to change this habit of growth. Topping tall growing trees to reduce the height often causes the crown to be poorly shaped, production of dense weak growing branches which are easily broken by wind and leaves large wounds that heal slowly at the point where the top is sawed off.

Tree Climbing

Extensive tree pruning necessitates the climbing of trees. Since tree climbing is dangerous work it is usually done by professional men who have the necessary equipment and experience. Workmen should take such precaution as may be necessary to reduce the danger of accidents.

Clothing

A tight fitting cap, boots with composition soles (not leather), breeches made of strong material and tight fitting jacket or shirt of strong material, are much more satisfactory than ordinary work clothes for tree climbing.

Rope

A 3-strand, rot treated one-half inch manila rope 120 to 150 feet long should be used. Avoid weakening the rope by cuts and abrasion, kinking, burning when run through a crotch too rapidly, and deterioration from improperly drying after being saturated with water. When used after a long period of storage the rope should be thoroughly inspected, and if its strength is questionable it should be tested by the weight of three men.

Using the rope with a safety saddle and figure-eight slip knot as shown at right makes tree pruning safer, allows movement

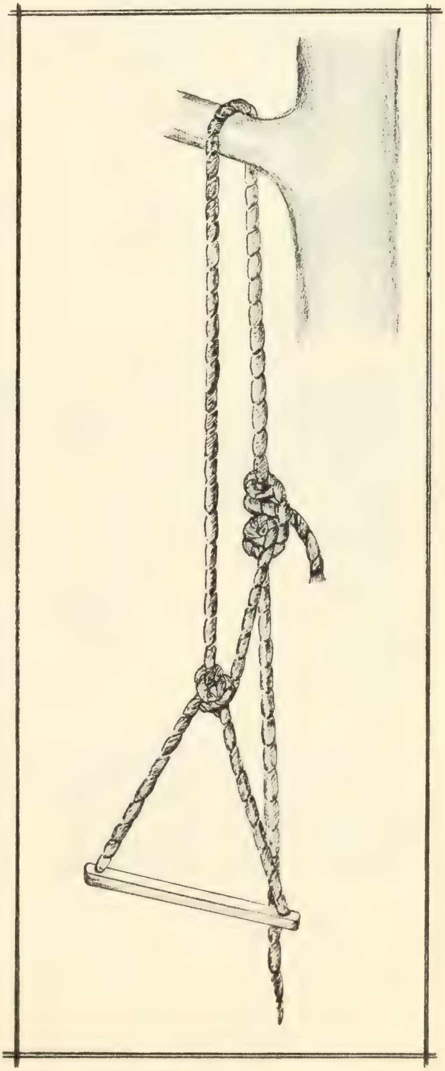


Figure 28—Safety sling for tree climbing

from one part of tree to another more quickly and permits the workman to reach parts of the tree that are often inaccessible without a safety sling. The procedure in pruning a tree is to climb toward the top of the tree, place the rope over a strong crotch near the top of the tree and tie the safety sling immediately so the workman can be safe in the saddle. Starting at the top of the tree with the pruning operation, work downward to the bottom of the tree. The workman should stay in the safety sling all the time he is working and keep all slack out of the rope.

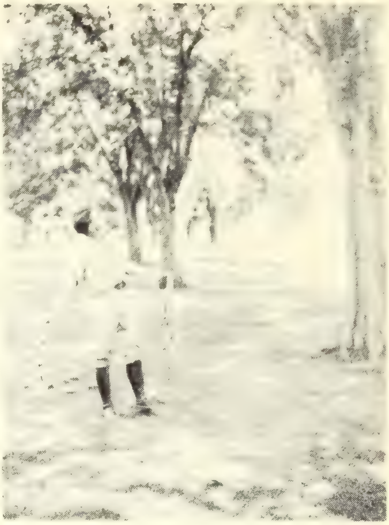


Figure 29—Rope ready to throw over lower branch

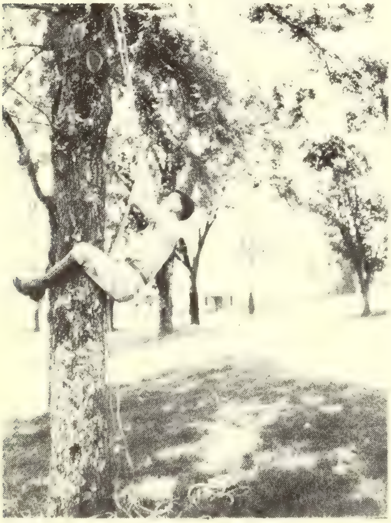


Figure 30—Climbing by rope to lower branches

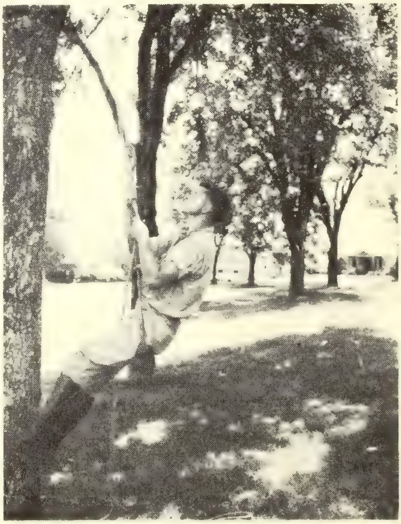


Figure 31—In the safety sling

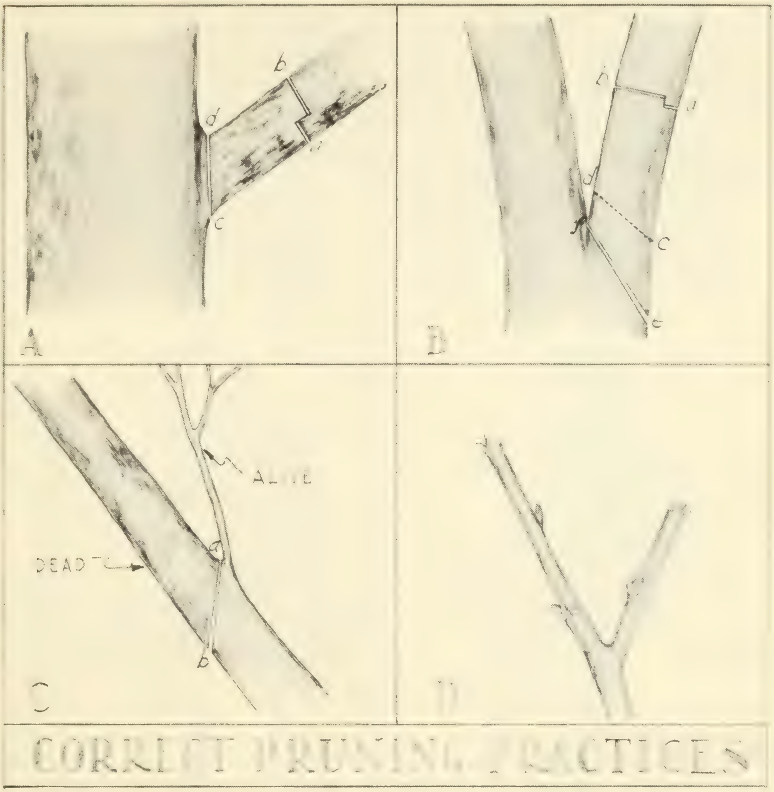


Figure 32

HOW TO CUT OFF BRANCHES

Pruning properly executed avoids expensive repair work later and danger of earlier death of the tree. The illustration shows desirable methods of making cuts in removal of branches 2 inches in diameter or above.

A. A preliminary cut (a) should be made about 1 foot from the final cut (cd). Saw at point (a) until the saw binds, when a second cut (b) is made. Saw about 1 inch at (c) to prevent the bark from peeling off when the final cut is made from (d) to (c).

B. Pruning a V-crotch should be done when the tree is small if possible. Preliminary cuts are made first at (a), then at (b). A cut at (cd) is desirable on larger trees since the weight of the falling branch is likely to tear a long strip of bark from the trunk. A final cut should be made from point (e) sawing in the direction of (f).

C. In removing a part of a large branch cut just above a lateral branch making a slanting cut (ab) so that the wood will heal quickly.

D. Cut small branches about one-fourth inch above bud.

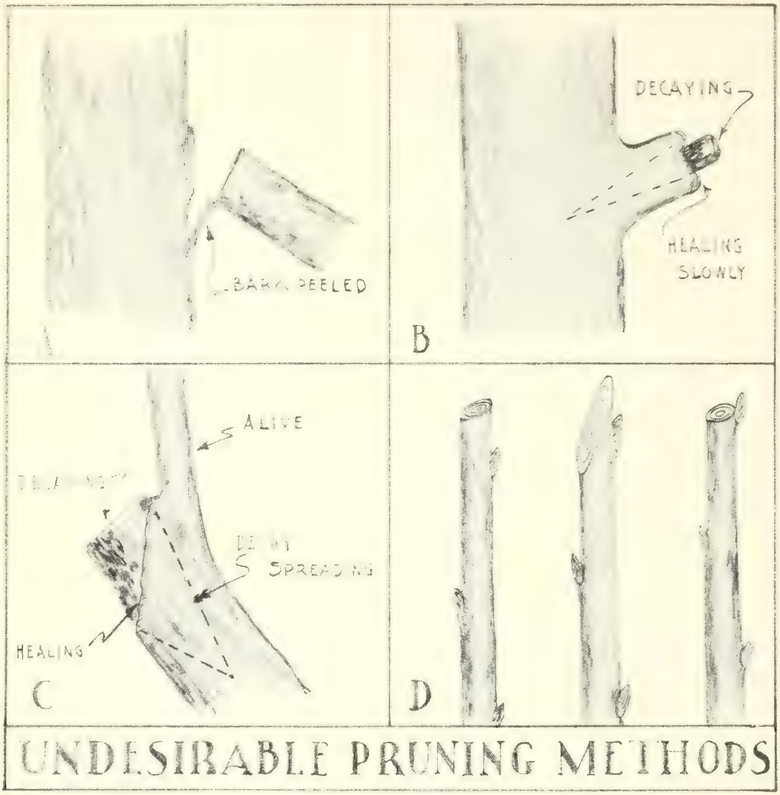


Figure 33

COMMON MISTAKES IN PRUNING

When trees are pruned, wounds are made where branches are removed. It is very important that the wounds are made in such a way that the exposed surfaces will heal quickly by providing a covering of bark for protection. Without the protection of bark, rot fungi are more likely to attack the tree. Lack of knowledge of how to remove a branch so as to facilitate quick healing has been the cause of the loss of many valuable trees in Mississippi. The illustration above shows some of the common mistakes that should be avoided.

A. The weight of the branch peels a long strip of bark off the tree trunk making a larger wound than necessary. The branch should be removed in two cuts as shown in figure 32, page 31.

B. Removing branches several inches from the trunk should be avoided. The flow of sap into the branch stub which remains is reduced to such an extent that the wounded surface heals slowly. Since many years are usually required for healing a wound under these conditions rot fungi usually attack the plant through the wounded surface. See figure 32, page 31, for correct place to make cut.

C. The sap flows the shortest distance through the branches from the leaves. The cut should have been made along the line indicated as healing. In this picture the end of the limb has died, the exposed wood is rotting and wound will not heal before the rot has spread into the branch and other parts of the tree. See figure 32, page 31, for correct method of removal.

D. The ends of small twigs die if not properly cut. From left to right twig cut too far above bud, cut at an angle so that bud dries out, and cut made too close to bud.

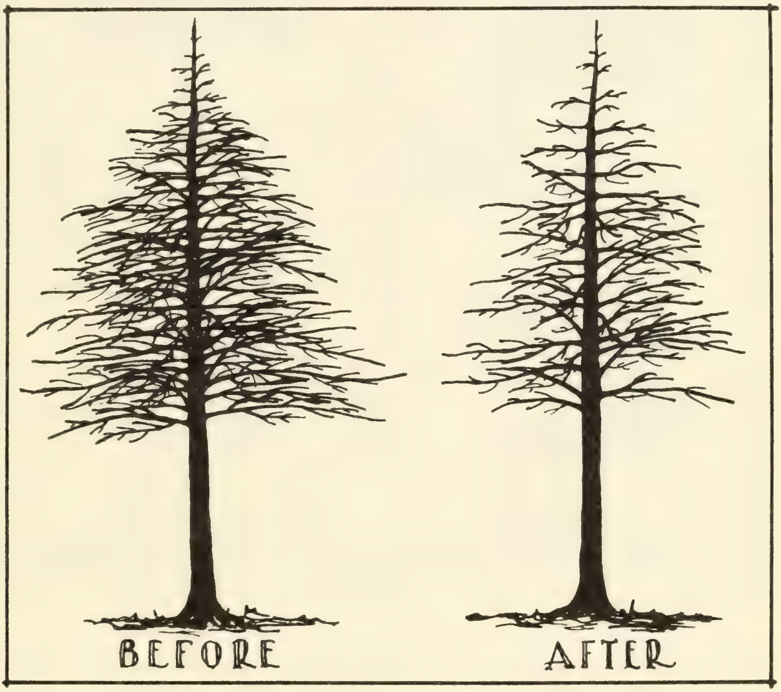


Figure 34

Pruning to Thin the Crown of Tree

Young shade trees which are growing vigorously usually need to be pruned to remove dead branches and thin out the weak branches where the growth is thick. A typical example of a tree which needs thinning is shown in the figure above at left. Usually entire branches are removed where the branches are crowded by sawing off at the main trunk. The thinning of weak branches allows sunlight to penetrate the crown of the tree. The removal of dead branches improves the appearance, removes rot producing fungi that may spread into the tree trunk and avoids the continual falling of small dead branches on the lawn.

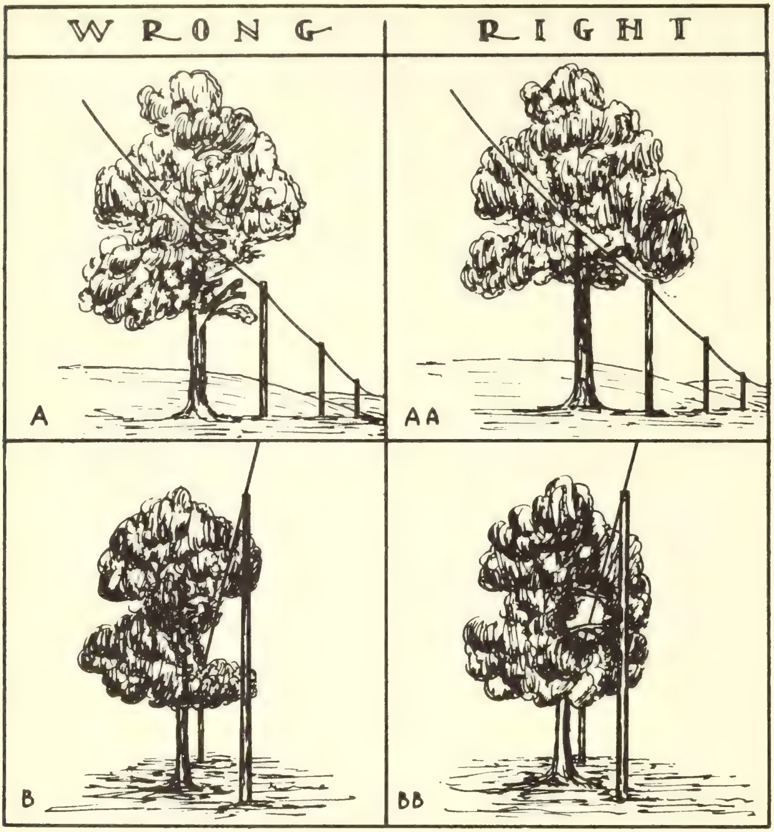


Figure 35

Right and Wrong Methods of Pruning for Low Voltage Power Lines

A More branches removed than needed for the necessary clearance; also branches cut in the wrong place. Final cuts should be made at the trunk of the tree so that wounds made by the cut can heal. Never leave stubs of branches where rot often begins and later spreads into the trunk of the tree.

AA Remove only lower branches to provide the necessary 2 to 3 foot clearance. Lower branches removed on all sides to give a well shaped crown. This method of under pruning is adapted only where the wire is low or the tree is tall with a majority of its branches above the wire.

B Poorly shaped crown results from removal of several large lateral branches which is not necessary for low voltage lines.

BB Only one large lateral branch and several small branches removed to provide the necessary clearance of 2 to 3 feet.

PRUNING FOR POWER LINES

Where a power line passes through a tree crown pruning is necessary to provide ample clearance. Such pruning can usually be done in such a manner that it will not disfigure the tree or imperil its existence. Transmission lines carrying less than 8000 volts require only 2 to 3 foot clearance. Removal of only one or two lateral branches will generally provide the necessary clearance without making a conspicuous opening through the crown that would mar its shape. High voltage lines which act as feeder lines to cities, towns, and communities require 6 feet or more clearance on all sides. This often necessitates the opening of a right-of-way in which entire trees must be removed. A small clearance for low voltage lines makes frequent pruning necessary and trees are often pruned so heavily that their usefulness is greatly impaired in order to save the expense of frequent pruning. Careless unskilled workmen often damage beyond repair street trees as well as trees growing on private property. Those who recognize the value of trees on the home grounds as well as public property should take definite steps to prevent unrestricted pruning practices.

WOUND TREATMENT

The bark of a tree protects the sap wood and heart wood against the invasion of rot fungi. Ordinary tree wounds more than 2 inches in diameter should be treated to prevent the entrance of rot fungi until bark can grow over the wound.

Wound treatment ordinarily consists of treating the exposed wood with a waterproof material. The wound dressing that is considered most satisfactory for general use is asphalt tree dressing which contains an asphalt base and antiseptic ingredients that disinfect the wound. This material can be easily applied with an ordinary paint brush. Although it sticks to the wood relatively well, usually the wound should be painted at least once each year until the wound has healed.

Linseed oil mixed with Bordeaux mixture to make a paste and applied with a brush often is used as a wound dressing. Although the ingredients are inexpensive and readily available it is not used extensively because the material does not stick to the wood well and must be applied repeatedly every few months to be effective.

Ordinary house paint is sometimes used but this material is thin, has no antiseptic ingredients and does not stick to the wood satisfactorily.

It is not advisable to paint fresh wounds if the surface is wet as the dressing will rarely stick. Better practice is to wait until the surface is dry and apply the dressing then. Occassionally cuts continue to drain after a long period. This is particularly true in the case of the American Elm.

This condition is commonly called slime flux which is often difficult to correct. By tapping the tree at the base using a one-half inch bit and boring to the heartwood the pressure is decreased as the sap flows out at the base of the plant.

Coniferous evergreens such as pines, cedars, and junipers produce resin and are not often attacked by rot. Wound treatment is not imperative in such instances.

The shape of wounds made by removing branches when pruning a tree are usually oval and ordinarily do not need to be reshaped to facilitate quick healing. The photographs on the page show how an irregular bark injury should be shaped to facilitate healing.

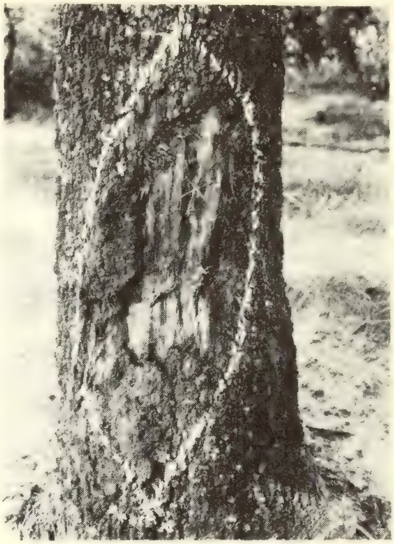


Figure 36

Irregularly shaped wound should be shaped like a boat so that the edge of the wound will be parallel to the flow of the sap.

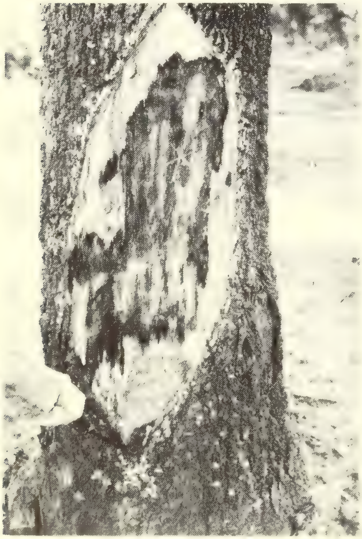


Figure 37

Use a chisel and mallet to remove all bark within the area outlined by the white crayon mark.

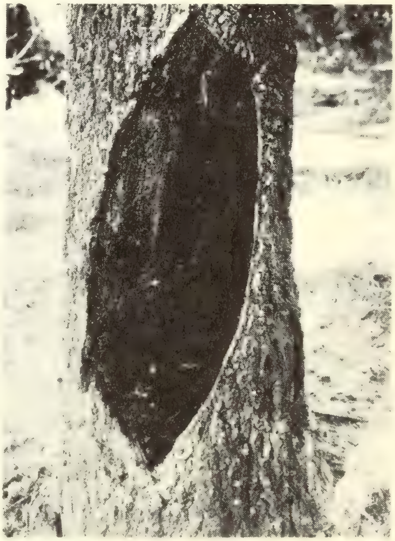


Figure 38

Apply shellac to the cambium for protection and then paint the surface of the wound with asphalt dressing or some other material.

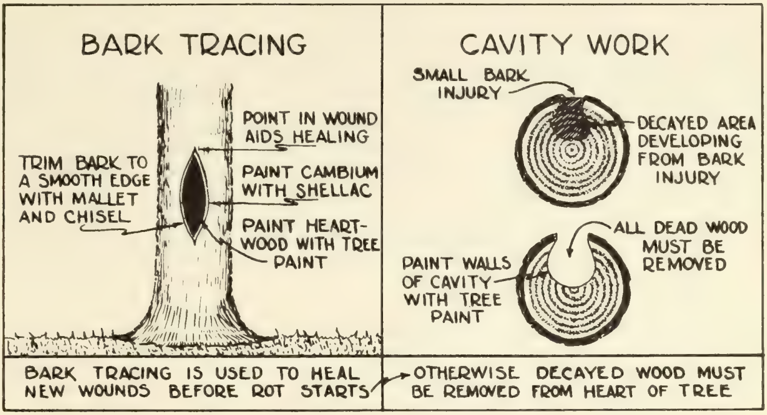

BARK TRACING
POINT IN WOUND AIDS HEALING
TRIM BARK TO A SMOOTH EDGE WITH MALLET AND CHISEL
PAINT CAMBIUM WITH SHELLAC
PAINT HEART-WOOD WITH TREE PAINT
BARK TRACING IS USED TO HEAL NEW WOUNDS BEFORE ROT STARTS
CAVITY WORK
SMALL BARK INJURY
DECAYED AREA DEVELOPING FROM BARK INJURY
ALL DEAD WOOD MUST BE REMOVED
PAINT WALLS OF CAVITY WITH TREE PAINT
OTHERWISE DECAYED WOOD MUST BE REMOVED FROM HEART OF TREE

Figure 39

CAVITIES

Most tree cavities result from lack of proper care of bark wounds. Rot often spreads rapidly causing large decayed areas in the sap and heart wood of trees. By properly shaping a bark wound so that it will heal rapidly and by keeping the wound painted regularly so that the wood remains dry all the time, the danger of cavities developing is greatly reduced. A few cents spent in the care of a wound may save the life of the tree or many dollars in excavating rotten wood and filling a cavity. Excavating and filling cavities is slow and expensive because good work is done only by skilled workmen who have the equipment, training and experience to do such work.

No attempt will be made to explain how tree cavities should be treated because of the extensive discussion that would be required and because in most cases work of this nature should not be attempted by the amateur. A home owner can do a great deal to prevent tree cavities by following the suggestions given on wound treatment on pages 35 and 36.

PRUNING SHRUBS

To maintain the beauty of a planting of shrubbery, proper pruning is necessary. Slow growing evergreens usually require little pruning; however, fast growing broadleaf evergreens and flowering shrubs should be pruned to remove surplus or undesirable growth at the proper time of year. Pruning is a dwarfing process and should be done for the following reasons:

1. To remove dead, diseased or injured branches
2. To remove old or surplus branches. Most vigorous growing shrubs should receive some pruning each year so that branches are removed when old and unsightly
3. Maintain a definite size or form
4. Influence flowering and fruiting
5. As an aid in transplanting by balancing the top with roots.

TIME AND EXTENT OF PRUNING

Most shrub pruning is done in the winter when plants are dormant. Such a practice is not harmful to the plant, but if heavy flowering and fruiting is expected annually the time of pruning should be determined by the age of the wood on which flowers and fruit are produced. In general shrubs may be placed in four groups according to time and extent of pruning. The first group includes those which grow slowly and are pruned to remove dead wood only. Common examples are flowering almond, flowering quince, pearlbush, viburnums and most broadleaf evergreens.

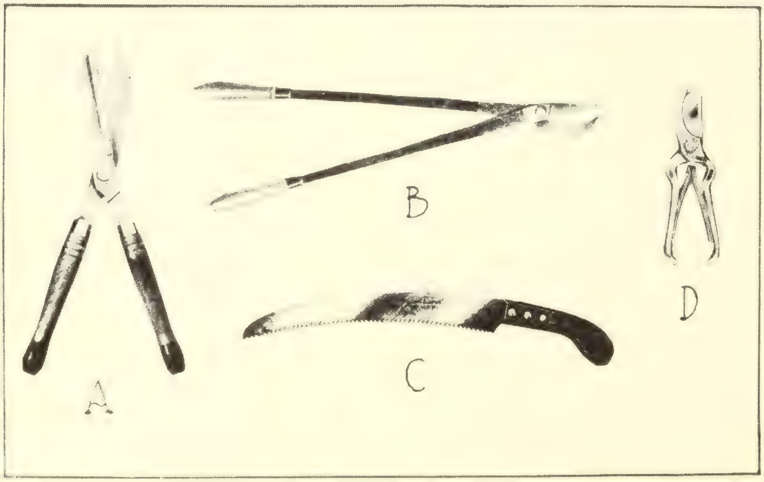


Figure 40

Tools. A· Hedge shears. B. Lopping shears for cutting large branches of shrubbery. C. Pruning saw. D. Pruning shears.

The second group includes plants which grow fairly rapidly and produce blooms on the previous year's growth and should be pruned immediately after blooming. Remove one-fifth to one-third of the previous year's growth. Included in the group are barberry, dogwoods, beautybush (kolkwitzia), deutzias, forsythias, jasmines (early blooming), spireas (early blooming), winter honeysuckle and weigelas.

The third group includes fairly rapidly growing plants which produce blooms on the current season's growth. These may be pruned at any time during the dormant season. Included in this group are althea, crepe myrtle, honeysuckle (except winter honeysuckle) and privets.

The fourth group includes plants that produce blooms on the current season's growth and may be pruned any time during the dormant season. These plants grow very rapidly, making it necessary to remove all two-year and older wood. Examples are butterflybush, coralberry, hydrangea, vitex, spirea (late blooming) and sumac.

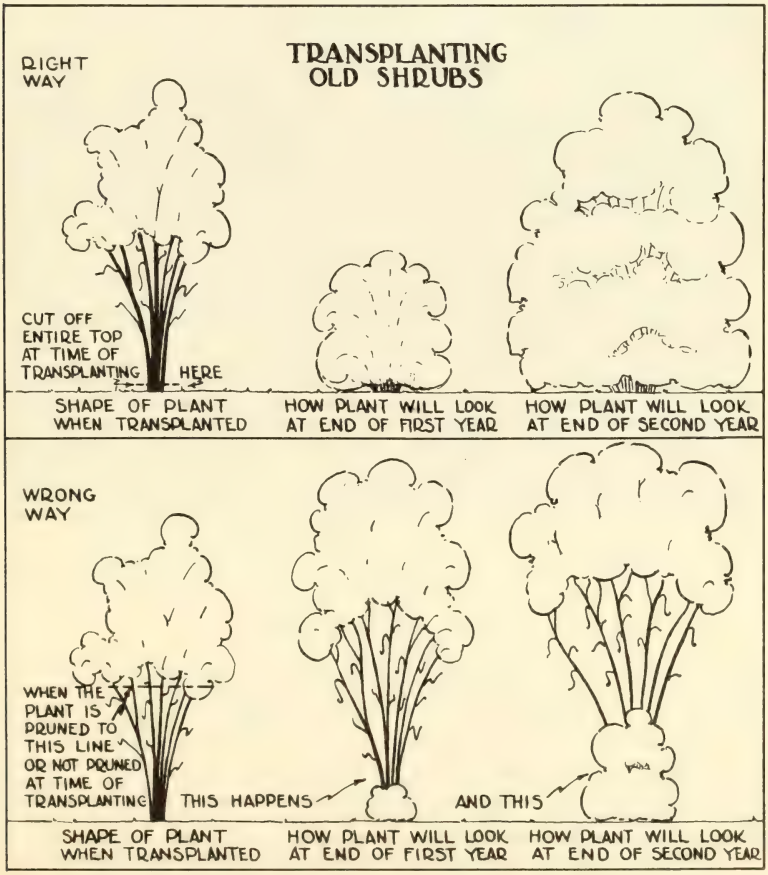

TRANSPLANTING OLD SHRUBS
RIGHT WAY
CUT OFF ENTIRE TOP AT TIME OF TRANSPLANTING HERE
SHAPE OF PLANT WHEN TRANSPLANTED
HOW PLANT WILL LOOK AT END OF FIRST YEAR
HOW PLANT WILL LOOK AT END OF SECOND YEAR
WRONG WAY
WHEN THE PLANT IS PRUNED TO THIS LINE OR NOT PRUNED AT TIME OF TRANSPLANTING
THIS HAPPENS
AND THIS
SHAPE OF PLANT WHEN TRANSPLANTED
HOW PLANT WILL LOOK AT END OF FIRST YEAR
HOW PLANT WILL LOOK AT END OF SECOND YEAR

Figure 41

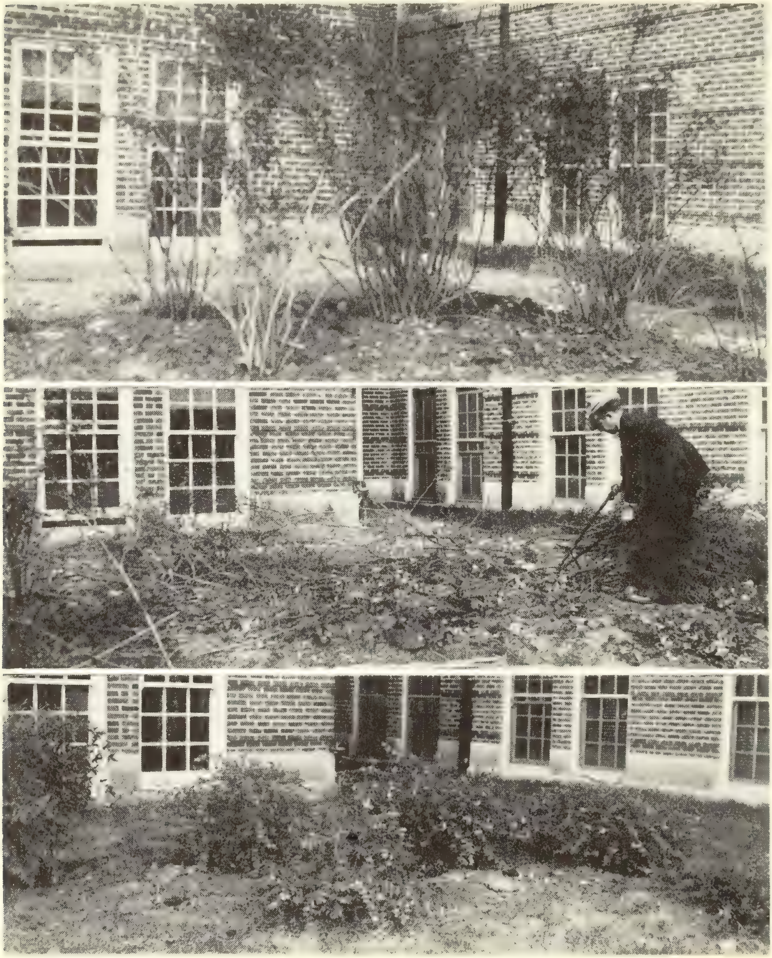


Figure 42—"Leggy" plants cut back to ground make well shaped shrubs the first year

HOW TO PRUNE

Remove all top. The most drastic method of pruning is to cut back to the ground as shown above. Poorly shaped, "leggy" shrubs, winter killed plants, and plants which have grown too high for a particular situation are usually best cut back to the ground. New growth is fast when top is removed because an extensive root system is present to provide water and nutrients for the top.

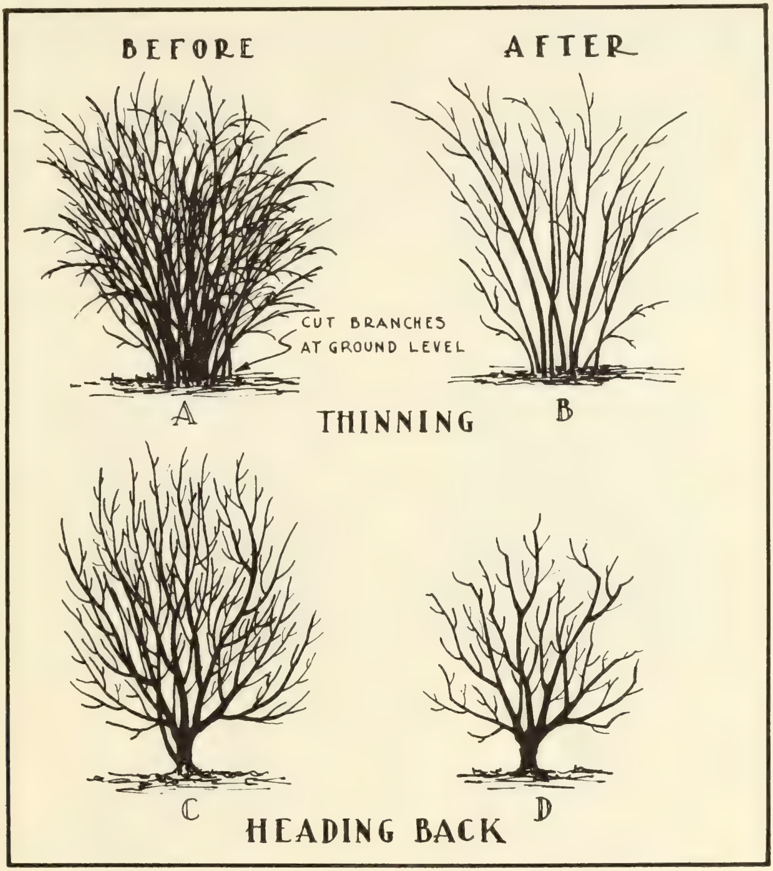


Figure 43

THINNING

Many shrubs send out shoots each year from the base of plants. These shoots branch and give rise to numerous smaller branches. Each succeeding year the growth of new shoots from a branch becomes less vigorous; consequently, production of blooms will be reduced. If dead, diseased, and older branches are removed each year, the plant is constantly renewed. Whenever growth of shoots on a branch becomes so small that flowering is unsatisfactory or branches become crowded, older branches should be removed at the ground as shown in A and B above. After the first pruning, it is advisable to prune each year. This annual pruning avoids the necessity of severe pruning as shown above leaving the plant looking unsightly until it recovers its normal appearance.

HEADING BACK

As shown above in C and D pruning is usually advisable when plants have grown too tall for a particular situation as in a foundation planting. Thin out some of older branches and cut back others at points where small shoots arise. Keep the natural shape of a plant as much as possible. New shoots will arise from all parts of the plant when pruning is done throughout the plant, thus producing a more desirable shape.

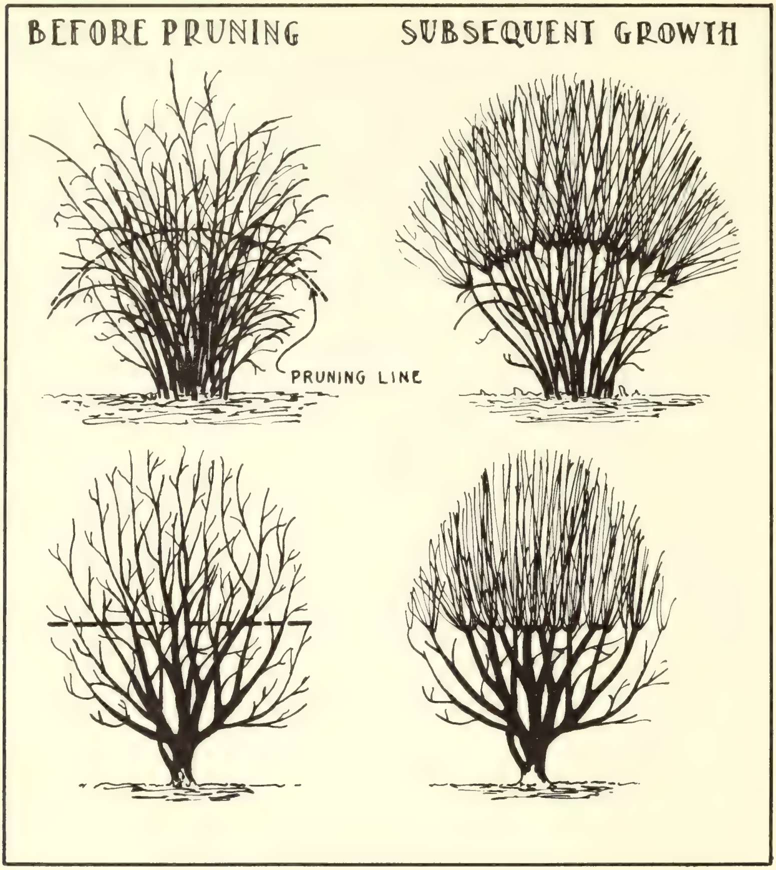


Figure 44—Common mistake in pruning

Heading back to a definite line as shown above produces a thick growth of new shoots at the top only and usually produces an unattractive "leggy" plant. See page 41 for correct methods of pruning.

PRUNING NARROWLEAF EVERGREENS

Narrowleaf evergreens are usually pruned only to influence the shape or compactness. Plants such as junipers, arborvitae, and cypresses are often sheared to make the plant more formal and increase the density of the growth. It is imperative that plants such as cannart red cedar and silver red cedar be pruned or sheared several times during the growing season to produce the desired compact growth. Heading back of the lateral branches of other narrow-leaved evergreens such as deodar cedar and pfitzer juniper produces a more compact desirably shaped plant. Plants which have a central leader such as the deodar cedar should be pruned to remove all leaders except one when the plant is small.

PRUNING HEDGES

Although the Chinese privet or amur privet is used commonly as clipped hedges in Mississippi there are many other plants adapted to the shaping and heavy shearing required of a formal hedge. Ordinarily the fine textured, vigorous growing plants are best adapted for hedges. Plants suitable for hedges are by no means limited to shrubs since trees such as pine, and red cedar, make a very satisfactory hedge. Some of the common plants that make a satisfactory clipped hedge are small leaved privets, Euonymus japonica, boxwood, cleyera, firethorns, yaupon, carolina cherrylaurel, arborvitae, red cedar, shortleaf pine, barberries, deutzias, and flowering quince.

Hedge shearing should start when the plants are not more than 6 to 8 inches high so that a thick growth will be produced at the bottom. If taller plants are used for a hedge the plants should be headed back to a height of about 4 to 6 inches unless the branching is thick near the ground. Old hedges that have become thin or V shaped may be cut back to the surface of the ground and started as a new hedge.

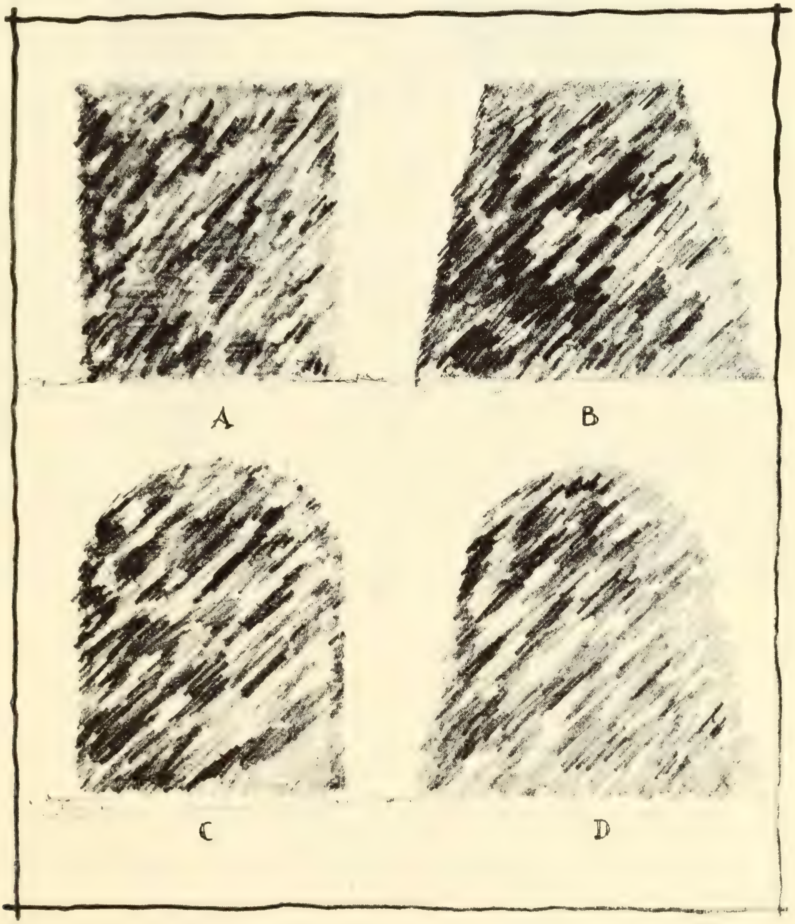
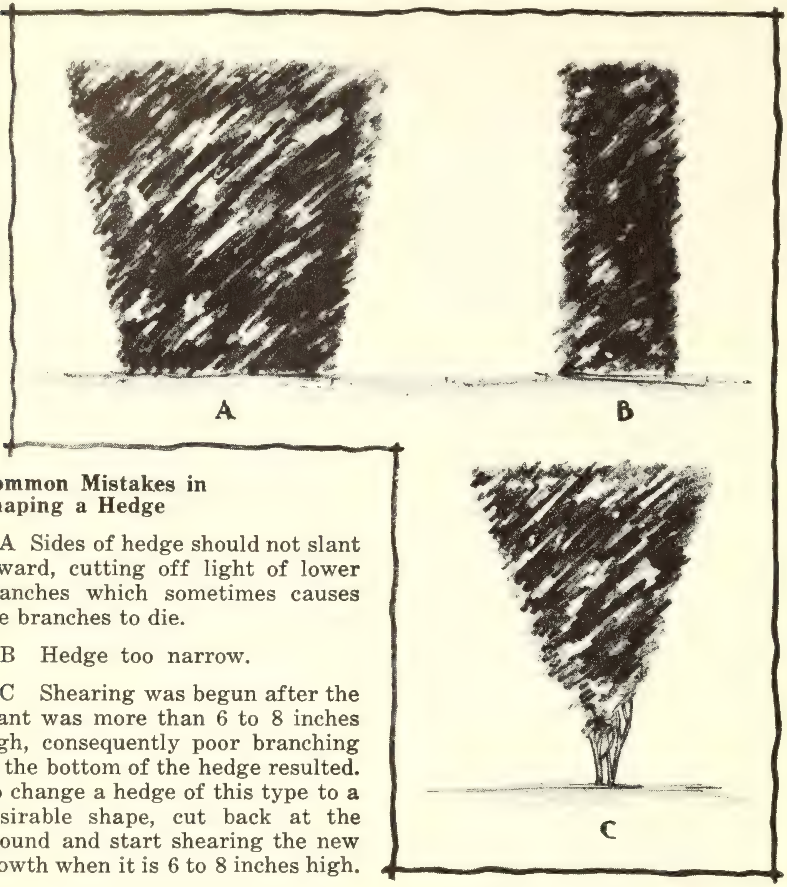


Figure 45—How to shape a hedge

How to Shape a Hedge

A hedge 3 to 6 feet wide at the base is more desirable than narrower hedges. Slanting sides as shown in B and D above are more desirable because the foliage gets more sunlight. The flat-topped hedge shown in A and B are easier to cut to a straight line consequently give a neater appearance than C and D.



Common Mistakes in Shaping a Hedge

A Sides of hedge should not slant inward, cutting off light of lower branches which sometimes causes the branches to die.

B Hedge too narrow.

C Shearing was begun after the plant was more than 6 to 8 inches high, consequently poor branching at the bottom of the hedge resulted. To change a hedge of this type to a desirable shape, cut back at the ground and start shearing the new growth when it is 6 to 8 inches high.

Figure 46

PRUNING ROSES

There are three general groups of roses and each require a different type of pruning. These general groups are: 1. Shrub roses; 2. Climbers and 3. Hybrid Tea, Tea and Hybrid Perpetual roses.

1. **Shrub roses** are used for landscape effects such as — rugosas, sweetbriars, cherokee and multiflora. Prune this group **after flowering,** remove only dead or diseased canes, and judiciously thin out entire canes when necessary. See thinning shrubs on page 41.

2. **Climbers, ramblers** and **pillar** roses should be pruned **after flowering,** removing all canes 3 years old and older. The 2-year wood can be shortened to 3 to 6 feet if the vine is on a low fence or trellis.

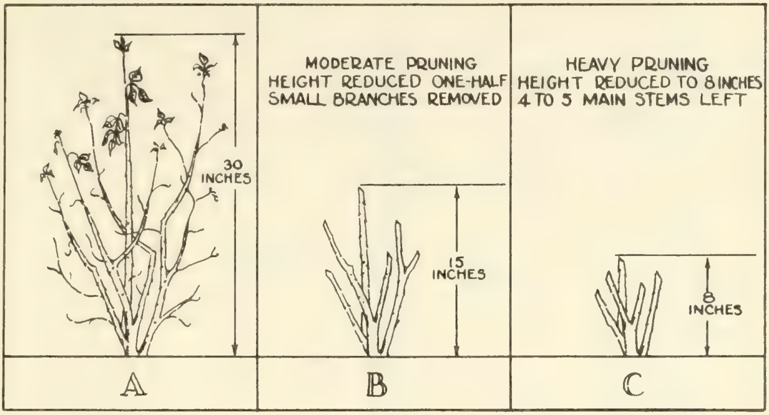

30 INCHES
MODERATE PRUNING
HEIGHT REDUCED ONE-HALF
SMALL BRANCHES REMOVED
15 INCHES
HEAVY PRUNING
HEIGHT REDUCED TO 8 INCHES
4 TO 5 MAIN STEMS LEFT
8 INCHES
A
B
C

Figure 47—How to prune a hybrid tea rose

3. Pruning a Hybrid Tea Rose

The above diagram shows two desirable methods of pruning an established plant. If a few large specimen flowers are desired, with a long season of bloom, heavy pruning (C) should be done. If several flowers of medium size are desired, moderate pruning (B) should be done. Vigorous roses such as Radiance and Etoile de Hollande will produce large flowers with moderate pruning (B). Weak roses such as Talisman and Lady Hillingdon should always receive heavy pruning (C) to induce growth.

Time to Prune

1. Prune all roses when they are planted, cutting away all of top except 3 or 4 canes and these should be left 3 to 4 inches above the ground. Also cut away broken or bruised roots.

2. Prune hybrid teas, teas and hybrid perpetuals in late February and March.

3. Prune shrub roses and climbers after flowering.

Summer Pruning

In cutting a rose, always cut back to a 5-parted leaf as shown by mark labelled (B) and (C) in diagram at right. This position of cut will start several buds on the stem and produce two long-stemmed roses. Had the rose been cut at position shown by mark at (A), only one short-stemmed rose would have developed. If the entire branch bearing the rose is broken off, there is no way for continuing the bloom from that branch.

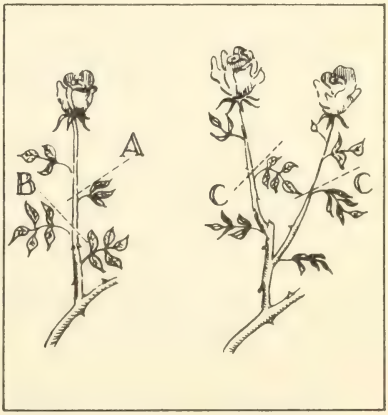


Figure 48

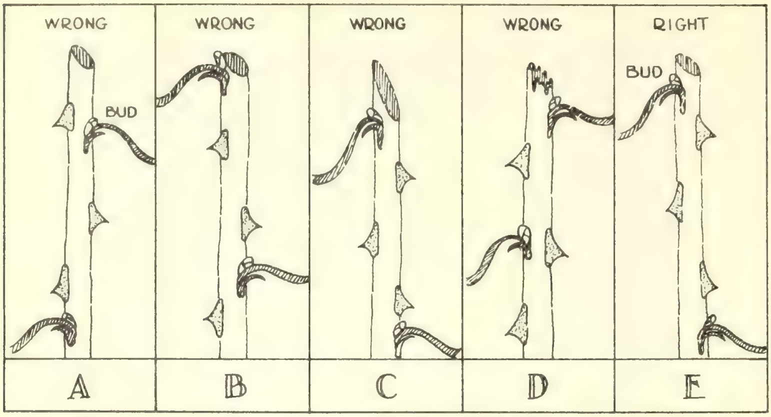


Figure 49

Where to Cut a Rose Cane

A. Too far from bud. B. Too close to bud. C. Too much slope. D. Jagged cut, damaged bud. E. Correct. Cut one-fourth inch above bud perpendicular to stem.

GRADING AROUND TREES

Since most of the roots of a tree are found near the surface of the ground, soil should not be excavated underneath the branch spread of a tree. A tree is likely to be injured in grading if as much as a few inches of additional soil is filled over the roots. A fill of heavy soil is likely to be more injurious than light soil. Filling without injuring the tree is difficult because a fill will greatly reduce the air supply for the roots and soil organisms which are found in the soil around the roots. Without an adequate supply of air in the soil around the roots, the roots die. If trees are to be saved it is necessary that provisions be made for an adequate supply of air to reach the roots after the fill is made and that the soil does not come in contact with the bark of the tree trunk above the original ground level.

A simple method of aerating the soil around the roots is to place a layer of large stones over the surface of the ground extending about as far from the trunk as the spread of the branches. Over this spread a layer of small stones or coarse gravel. Place vertical tiles at intervals of about 10 feet to permit circulation of air from the finished grade to the layer of coarse stones. About 2 feet from the trunk construct a well around the trunk to keep the soil from coming in contact with the bark. Soil allowed to remain in contact with the bark of a tree is likely to girdle and kill the tree. See diagram, figure 50, page 47.

Some of the trees most difficult to save in filling about them are evergreens, beeches, red oak and white oak. Some trees easiest to save are poplars, willows and sycamores.

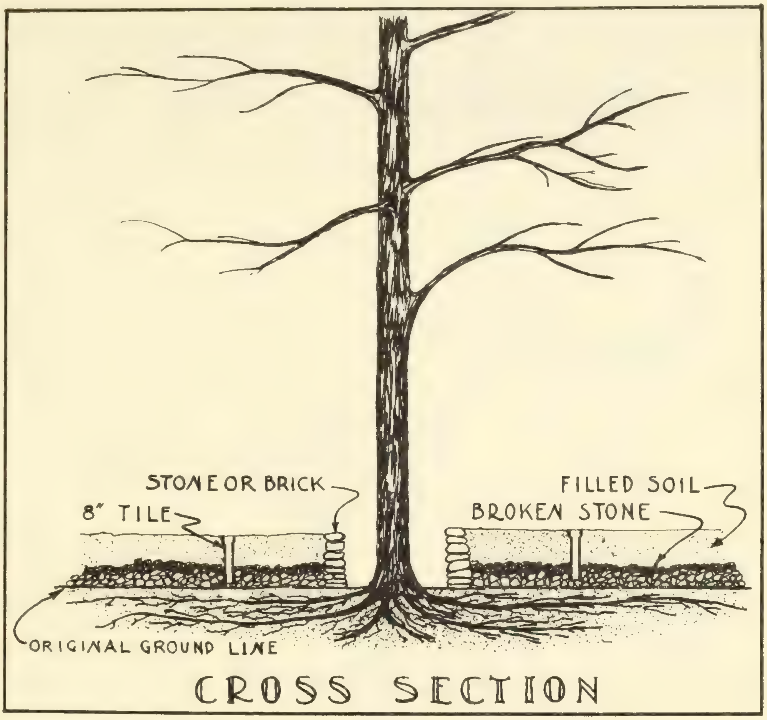


Figure 50—How to fill around a tree

Construct a "dry-well" around the trunk of tree to keep soil from coming in contact with bark of trees. Stone placed on ground to provide circulation of air from vertical tiles to soil around the roots.

TREE BRACING

Tree bracing is an important phase of tree care and achieves its fullest purpose in preventing rather than correcting damage. Bracing not only prevents the breaking or splitting of parts of trees but prevents the making of wounds which are likely to be entrance areas for rot fungi. There are many situations in which braces should be installed; however, only braces that are fairly easy to install and more commonly needed will be discussed in this bulletin. There are such common needs for bracing as V shaped crotches, long heavy branches likely to be broken by wind, trees close to buildings and trees with inherently weak branches.

Incorrect bracing is often more harmful than helpful. One should use bracing materials which are strong; the installation should be correct from an engineering viewpoint; the installation should injure the tree as little as possible; and the braces should be inconspicuous in place.

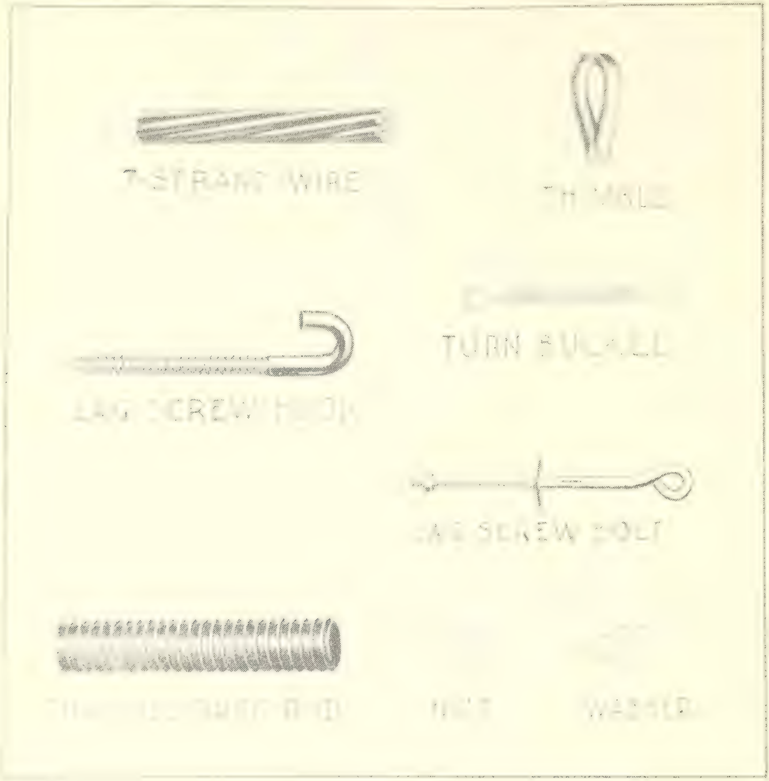


Figure 51

MATERIALS

Some of the standard materials used for bracing are shown above. Flexible cables made of 7 wire galvanized strands $\frac{3}{16}$ to ½ inch in diameter commonly used. Lag screw hooks ¼ to ⅝ inch in diameter used to screw in branches for cable attachment.

Threaded screw rod used in crotch bracing

Thimble used to make an eye-splice

Turnbuckles are not necessary in cable bracing, but cables can be made taut easier by using them

Lag screw bolt is used instead of lag screw hook when installation of cable is made in a tree which has very soft wood

Nut and washer used on lag bolt. Diamond shape washer is better than round washer. See page 50 for installation.

CABLING

Flexible cables used to strengthen weak crotch or branches are usually placed as high in the tree as practicable to achieve a maximum efficiency with a small cable. Usually the cable is placed two-thirds of the distance from the crotch to the end of the branch, and as nearly as practicable the lags should be installed equidistance from the crotch. Cables should not be placed so that they rub against limbs nor placed less than six inches above a crotch inter-section. Although we have no formula for determining the size cable to use for bracing branches of different sizes, experienced men have concluded that a ¼ inch cable is a safe size for limbs up to six inches in diameter at the point of attachment, $\frac{5}{16}$ inch cable is satisfactory for limbs up to ten inches in diameter at the point of attachment.

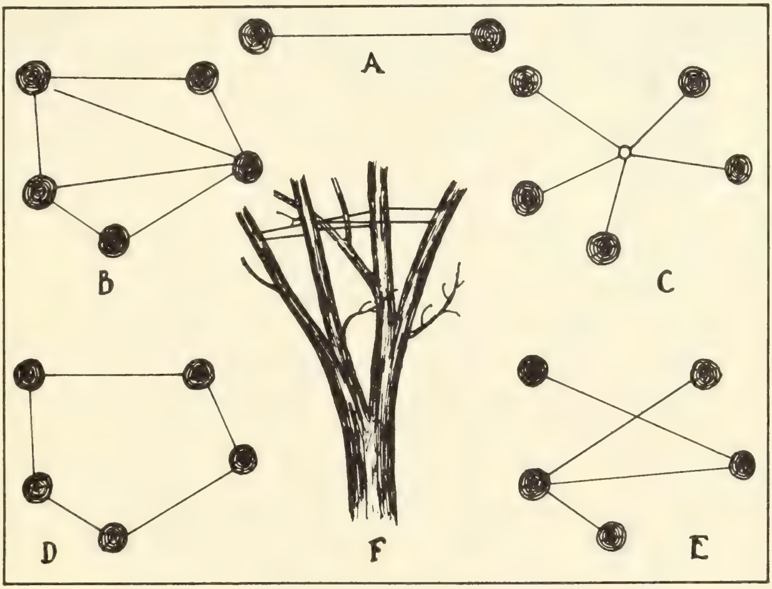


Figure 52

CABLING SYSTEMS

The above cross-section diagrams show various systems that may be used in bracing branches with cables.

A **Simple Direct**—A single cable directly supporting two limbs arising from a single crotch

B **Triangular**—Probably the best system providing direct support for weak crotches and provides lateral supports which minimize twisting

C **Box or Rotary**—Each connecting limb given lateral support but no direct support of weak crotches

D **Hub and Spoke**—Cables radiate from a ring in center. This system is of minor value since no lateral support and little direct support are provided

E **Multiple Direct**—Direct support provided but no lateral support

F Perspective of triangular system

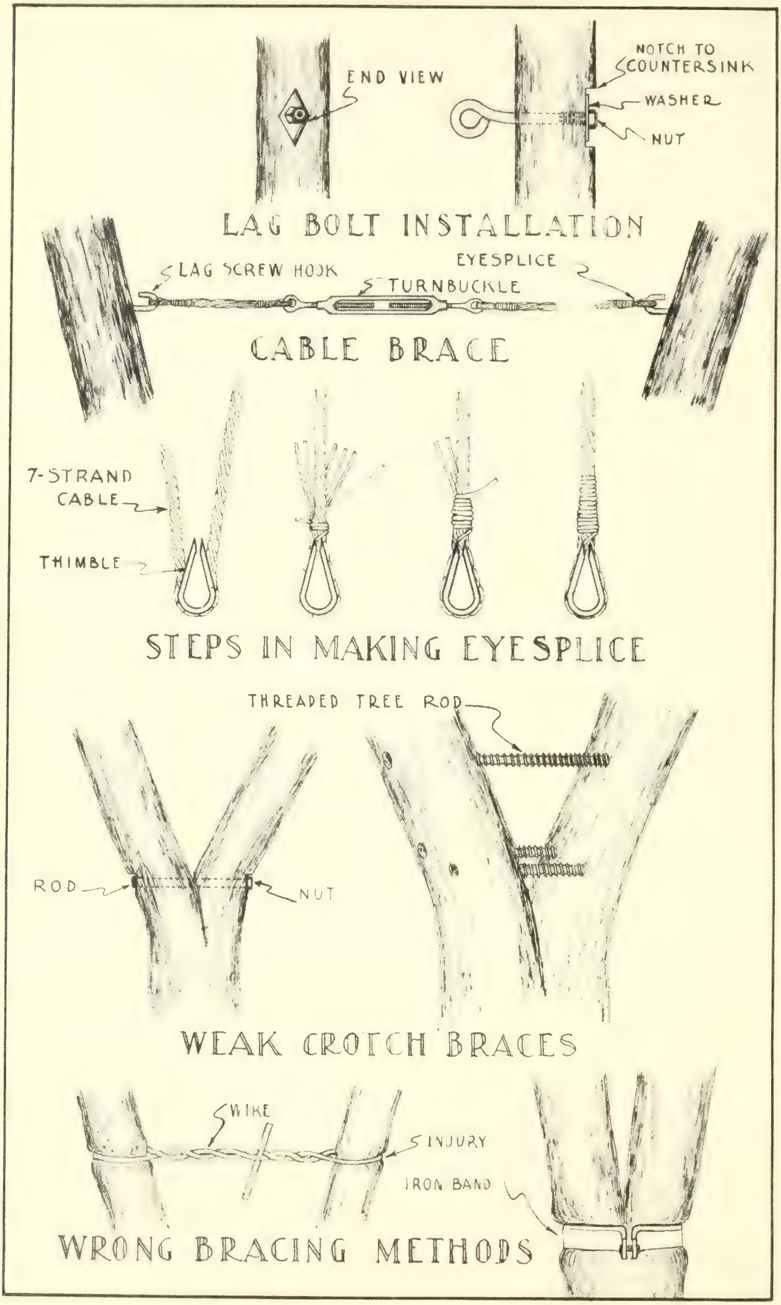

END VIEW
NOTCH TO COUNTERSINK
WASHER
NUT
LAG BOLT INSTALLATION
LAG SCREW HOOK
EYESPLICE
TURNBUCKLE
CABLE BRACE
7-STRAND CABLE
THIMBLE
STEPS IN MAKING EYESPLICE
THREADED TREE ROD
ROD
NUT
WEAK CROTCH BRACES
WIRE
INJURY
IRON BAND
WRONG BRACING METHODS

Figure 53

BRACE INSTALLATION

Methods of brace installation are illustrated on the opposite page and will be described from top to bottom.

Lag-bolt Installation. Lag bolts used to anchor the cable are installed by first drilling a hole the same diameter as the lag bolt to be inserted. The hole should be bored so that the bolt and cable will form a straight line. With a chisel notch one end the exact shape of the washer to a depth of about one-eighth inch below the bark. Before inserting bolt, cover bolt with tree dressing so that water and air are excluded. Paint the splices, nuts, washers and wound with tree dressing.

A Cable Brace is installed by first locating the position of lag screws on the limb. Lag screws rather than lag bolts are used when bracing trees with hard wood. Lag screws are usually inserted in holes which are drilled one-sixteenth inch smaller in diameter than the lag. Drill hole slightly deeper than the length of the lag thread to prevent splitting, and it should be so drilled that the cable and lag form a straight line at the point of attachment. Lags should be screwed up to a point which will just allow the cable to slip over the hooks. The turnbuckle provides means of the cable being drawn taut. Eye-splices should be made as shown by drawing.

Weak crotches may be braced by using a cable as already shown, by using rods or a combination of these methods. The rigid bracing that a rod provides is not often necessary except in cases of crotches that have already split. In the case of large trees several parallel rods may be necessary for adequate crotch bracing. Such installation is usually better done by men well trained in work of this nature.

Do not make the mistake of placing wires or bands which do not allow the plant to grow normally. Such methods are expensive and injurious to trees.

INSECT CONTROL

In the control of insect pests some knowledge of how they feed and breathe is essential for best results in using insecticides. So far as feeding habits are concerned insects in general may be divided into two groups, those with biting mouth parts and those with sucking mouth parts. Examples of insects with biting mouth parts are beetles and caterpillars. Such insects have jaws that are similar to a pair of hedge shears, in which small pieces are cut from the leaf, bud, or flower and then chewed and swallowed. Biting insects are usually controlled through the use of stomach poisons· If a plant is sprayed with such a chemical as arsenate of lead, the insect will be poisoned when it eats a part of the plant that is covered with the insecticide.

The sucking insect has a short beak which extends from the lower part of its head. Within this beak are slender needle-like filaments which fit together and form a small tube. The insect pushes this little tube down through the leaf or other part of the plant and through it pumps up the sap. A stomach poison such as arsenate of lead sprayed on the foliage has no effect on the sucking insects, since they never eat the plant tissue. To control these pests it is necessary to use a material which hits the body of the insect. Such a preparation is generally called a contact insecticide, and nicotine is one of the best known insecticides of its kind. Of the sucking insects, some of the most common are plant lice, mealy bug, and scale insects.

To understand how a contact insecticide kills one must know how an insect breathes. Most insects breathe by means of a system of air tubes which extend to all parts of the body. The air enters these tubes through a series of openings down each side of the insect. Most contact insecticides such as oil emulsion kill by clogging the openings through which the air passes into the body, and the insect dies of suffocation. Other insecticides such as nicotine in the control of aphids enter the openings and penetrate the walls of the tubes, causing damage to the tissues. In still other cases such as lime sulphur in the control of scale insects, the insect's body is corroded by the insecticide. It is evident that a contact insecticide can be effective only when it actually comes in direct contact with the body of the insect. The thoroughness with which the insecticide covers the body of the insect and the force with which the spray material hits the body of the insect will influence the effectiveness of the insecticide. For this reason it is advisable, when possible, to use a high pressure sprayer in the control of sucking insects such as shown, figure 54, page 53.

DISEASE CONTROL

Satisfactory control measures for diseases of ornamental plants are usually preventives rather than cures. Most diseases can be prevented if control measures are used before the appearance of disease. When once a plant becomes affected with a disease, often the only remedy is to destroy it and start over. In the great majority of instances a disease can be kept from spreading by using certain control measures. The use of fungicides, proper growing condition, healthy propagating stock and strict sanitary measures are the most important practices which the grower can put into effect to prevent disease.

Fungicides commonly used on plants contain either sulphur or copper as the toxic agent. Several mixtures containing one or the other of these elements are available commercially. No one fungicide has yet been found which is effective in the control of all diseases. To obtain effective control the correct fungicide must be used and must be properly applied. Thoroughness is extremely important in applying either sprays or dusts; the entire surface of leaves and stems must be covered. Fungicides are generally more effective when applied before rains rather than afterwards. It is during wet periods that many diseases spread, and the plant becomes diseased unless it is protected by the presence of a fungicide.

Since thoroughness of application is essential it is important that suitable sprayers and dusters be used. Small, cheap equipment often covers the plants only partially, consequently unsatisfactory results occur. Low pressure sprayers do not break the spray into a fine mist and in general are not as effective as high pressure machines.

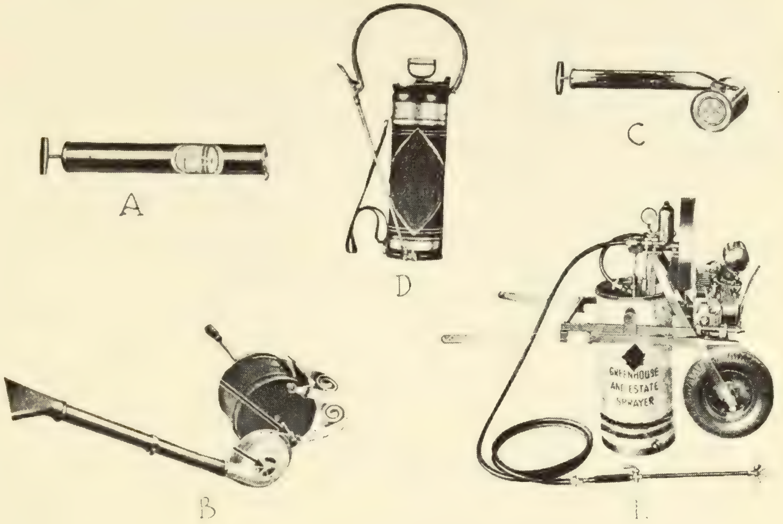


Figure 54

Dusting and spraying equipment: A. Small dusting gun too small for dusting shrubs or trees. B. A desirable type duster that has an agitator and develops a blast of air that prevents clogging and breaks the powder into a fine floating dust. C. Small hand sprayer that is usually undesirable particularly in applying contact sprays. D. A popular type sprayer that is usually satisfactory for ordinary home use. E. Wheelbarrow type power sprayer is efficient and economical for use on estates, parks, and large public areas.

CONTROL FOR COMMON INSECTS AND DISEASES OF ORNAMENTAL TREES AND SHRUBS

Control during Spring and Summer Season, March to October

Name of Pest	Plants Attacked	Description of Pest	Treatment
Aphids (Plant lice)	Rose, spirea, euonymus viburnum many others	Small sucking insects that are green, red, black in color	Spray with 2 teaspoonfuls nicotine*, 1 cubic inch soap, 1 gal. water, or use derris dust
Azalea lacebug	Azaleas, pyracanthas	⅛ inch long $\frac{1}{16}$ inch wide. Lace-like wings with brown and black markings	White oil emulsion 3 teaspoons, powdered derris 2 tablespoons, and one gal. water
Bag worm	Arborvitae red cedar junipers other evergreens	Spindle shaped, bag-like shelters. First appear in May	Picking bags in spring and fall. 12 teaspoonfuls lead arsenate to 1 gal. water, or 4 lbs. lead arsenate to 50 gallons water
Black spot (disease)	Rose	Black spots on leaves and stems	Regular application of dry dusting sulphur every 2 weeks. Burn diseased leaves
Camellia scales	Camellias	Cottony mass, small brown specks	White oil emulsion 1/50
Canker (disease)	Lombardy poplar, pussy willow, rose	Cankered areas on bark	Cutting out infested parts in February
Fall web-worm	Elm, walnut, pecan, persimmon variety of trees	Webbing inclosing tips of branches	3 teaspoonfuls lead arsenate to 1 gal. water or 1½ lbs. lead arsenate to 50 gal. water. Cut out nests.
Flat-headed apple tree borer	Pecan, elm, apple, oak	Boring trees under bark, especially in young transplanted trees and weakened trees	Keep trees vigorous. Wrap trunk. Carbon bisulphide placed in tunnels with eyedropper
Leaf spots	Euonymus crepe myrtle camellia many others	Various color spots on leaves	Bordeaux mixture 4-4-50
Mildew (disease)	Rose, crepe myrtle variety of plants	Whitish covering of leaves	Regular applications of dry dusting sulphur, every week during rainy weather

*Nicotine sulphate or Blackleaf 40.

Name of Pest	Plants Attacked	Description of Pest	Treatment
Mealy-bug	Gardenia, azalea	Large cottony masses in forks of limbs	Miscible oil 1-50 with cleaning away of litter
Oleander scale	English Ivy oleander	Yellowish Scale	Nicotine soap* ¾-100-4, when blackberries are in bloom
Red spider	Arborvitae, junipers boxwood, rose many others	Fading of leaves to pale gray color· Leaves covered with fine web. Thousands of tiny mites crawling over plant	Miscible oil 1-50 in early spring, sulphur dust in growing season. Syringe with cold water on small infestations
Rose chafer or other rose beetles	Rose, apple, variety of plants	Yellowish-brown beetle	5 lbs. lead arsenate* and 5 lbs. hydrated lime in 50 gal. water
Slugs or rose worms	Rose, variety of plants	Slugs on leaves are ¾ in. long, greenish in color. Skeletonize the leaves	Lead arsenate, 3 teaspoonfuls to 1 gal. water
Thrip	Rose, azaleas camellias many others	Very small; young ones yellow, adults black. Flowers fail to open	1½ teaspoonfuls nicotine, 1 oz. soap, 1 gal. water
Twig blight and Nursery blight	Red cedar, arborvitae, cypress, chamaecyparis	Dead tips of twigs	Prune tips. Bordeaux 4-4-50, or sulphur dust
Whitefly	Dogwood, cape jasmine, laurel, ligustrums, chinaberry, citrus	Small white flies on leaves. Smutty appearance on leaves	Nicotine ½ pt., 2 lbs.* soap, 50 gals. water; or 1 gal· oil emulsion to 50 gals. water
Woolly aphid	Apple elm	Curled leaves	No treatment effective

*See directions on last page for small quantity measurements.

Control during dormant season, November to March

Name of Pest	Plants Attacked	Description of Pest	Treatment
Cedar apple rust	Red cedar in winter. Apple, haw, pyracantha in summer	Hard, brown galls in winter. Red gelatinous growth on branches of cedar in spring. Red leafspots on apples	Pick growths off cedar in winter
Cottony maple scale	Soft maples	Cottony matter projecting from brown scales	Oil emulsion 1/40
Euonymus scale	Euonymus bittersweet	Brown scales mixed with small white ones	Oil emulsion 1/40 Continue through season
Magnolia scale	Magnolia	Large waxy white scales ½ in. diameter	Oil emulsion 1/20
San Jose scale	Apple, pyracantha, quince, crataegus, flowering peach, crabs, cherries	Circular grayish scales 1/16 in. diameter when full grown	Oil emulsion 1/20

*Oil emulsion is a mixture of oil that will mix with water. The formula 1/40 means to use one part of oil emulsion to 40 parts water. Oil emulsion is sold under several trade names such as Garden Volck, Nursery Volck and Scalecide.

INSECT AND DISEASE CONTROL MATERIALS AND HOW TO USE THEM

LEAD ARSENATE: Use for all leaf feeders such as caterpillars, worms, chewing beetles, etc. The usual rate of application for SMALL QUANTITIES is 3 teaspoonfuls of lead arsenate plus 3 teaspoonfuls of hydrated lime in 1 gallon of water. The proportion for LARGER QUANTITIES is 1 pound lead arsenate and 5 pounds hydrated lime in 50 gallons of water.

DERRIS: A plant extract containing rotenone. It is not poisonous to man but is both a stomach and contact poison to insects. It is used either as a dust containing ¾% rotenone or as a spray using 6 teaspoonfuls of 4% derris dust to 1 gallon of water.

NICOTINE: Used for plant lice, thrips, red spider, white flies and other soft-bodied insects. The usual formula for SMALL QUANTITIES is 1 to 2 teaspoonfuls of nicotine sulphate (Blackleaf 40) in 1 gallon of water in which a cubic inch of soap is dissolved. For LARGE QUANTITIES use ¾ pint nicotine plus 4 lbs. soap to 100 gallons of water. If a NICOTINE DUST is preferred (dust is easier to apply if you have an inexpensive dust gun) it may be made in small quantities as follows: Place 19 ounces of hydrated lime in a gallon molasses can. Add 1 ounce of nicotine sulphate and a handful of small rocks. The cover is then tightly closed and the can shaken vigorously for 2 minutes. The dust is ready for use. It should be used immediately.

PYRETHRUM: Used for same purpose as nicotine. It is sold under such trade name as Red Arrow, which is applied as a spray. Directions given on container.

OIL EMULSION AND MISCIBLE OIL: These are both used especially for scale insects. The oil emulsion is thick and creamy, while the miscible oil is a clear color like lubricating oil. Both mix readily with water—turning a milky white. For winter applications they are usually mixed at the rate of 1 part oil emulsion or miscible oil to 20 parts of water. The summer sprays are mixed 1 part emulsion to 40 or 50 parts of water.

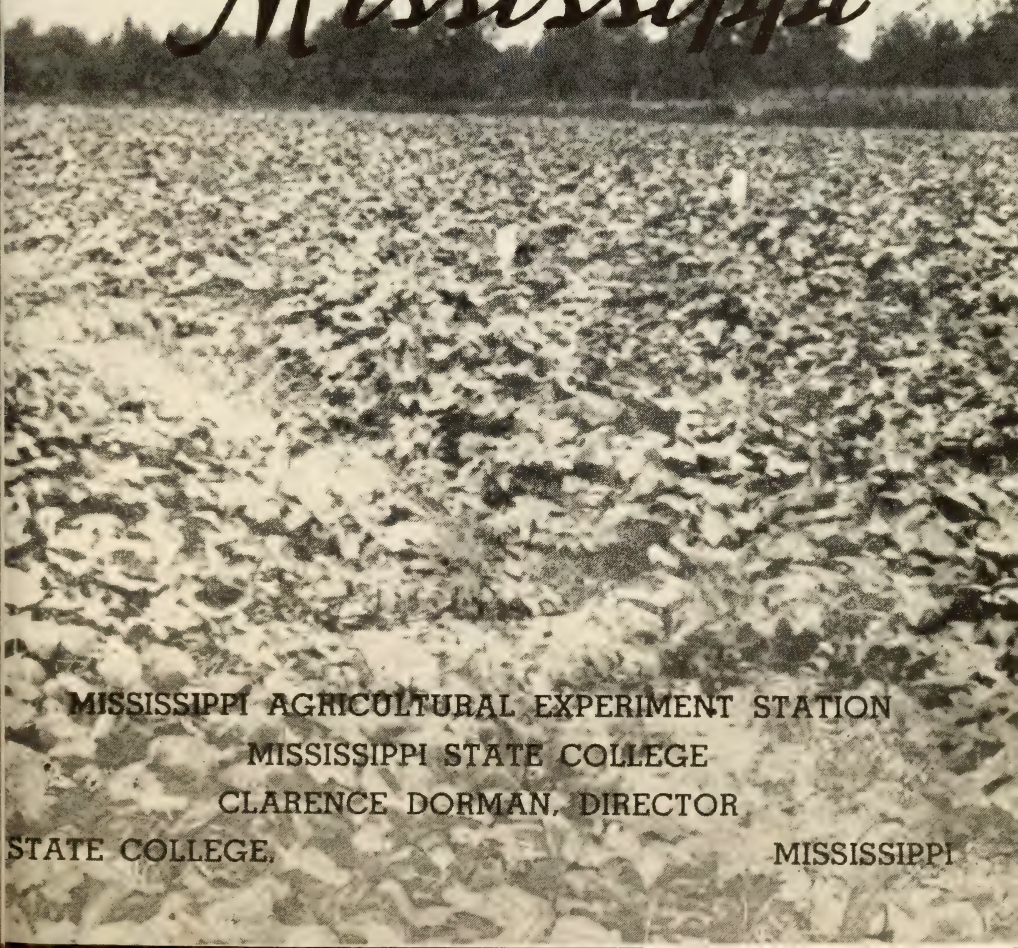
DUSTING SULPHUR: This is very useful in controlling red spider, black spot and mildew. It is a finely divided sulphur dust, and more effective than ordinary flowers of sulphur. Wettable sulphur is available for liquid sulphur sprays.

CARBON BISULPHIDE: A liquid gas to treat borers and to eradicate ant nests.

Information about the control of insect pests and plant diseases may be secured at any time from the State Plant Board at State College. Specimens of any insects or diseases causing injury should also be sent to the State Plant Board for identification.

Bulletin No. 355 April, 1941

Growing Cucumbers *for* Pickling in *Mississippi*



MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
MISSISSIPPI STATE COLLEGE
CLARENCE DORMAN, DIRECTOR
STATE COLLEGE, MISSISSIPPI

Growing Cucumbers For Pickling In Mississippi

By W. S. ANDERSON

The growing of cucumbers for pickling is an industry distributed over a wide portion of the United States. Nearly 5 million bushels were used for pickles annually for the period of 1927 to 1936, and the farm value of pickle cucumbers was 5.1 million dollars in 1937 and 3.8 million dollars in 1938.

Data compiled by the Bureau of Agricultural Economics, U. S. Department of Agriculture, show in table 1 that the United States acreage of cucumbers for pickling in the years 1927-36 was 77,020 acres. This 10-year average was considerably smaller than that for 1937 and some less than that for 1938. Though two north central states, Michigan and Wisconsin, produced in this period about one-third of the pickling cucumbers, the states of Indiana, Ohio, Minnesota, Colorado, and California also grew large quantities.

Mississippi has not been considered an important pickle cucumber producing state, and is actually included in the statistical table with 21 other states under the listing "other states." In some years, however, the planting of pickling cucumbers in Mississippi has been as high as 6,000 acres, producing a total yield of more than 400,000 bushels, having a farm value of approximately one-quarter million dollars. Because cucumbers are grown mostly in small patches of 1 or 2 acres by each grower, this industry affects 3000 to 4000 farmers in this state.

Pickling cucumbers are grown only under contract with packers, and for that reason production is centralized either in proximity to factories operated by the contracting packers or near their brining and receiving stations. In South Mississippi pickling cucumbers are grown in approximately 30 counties, and delivered to more than 15 brining stations or nearly 50 "receiving" stations. The latter group includes both brining and grading stations. Figure 1 shows a typical receiving station where the growers deliver their crop.

In the contracts between the packers and the growers a price is specifically agreed upon for the various grades of pickling cucumbers, even before the crop is planted. Thus the grower's returns for each bushel are fixed for a season and do not fluctuate during the producing season as do the returns from many truck crops grown for commercial purposes. This fixed seasonal price has been an incentive for farmers to contract for growing pickling cucumbers. The crop, being relatively easy to grow and not exceedingly expensive to produce, furnishes an important additional cash income crop for those farmers who are located in the pickle contracting areas of the state.

CUCUMBER EXPERIMENTS BY MISSISSIPPI STATION

Because of the importance of the crop to Mississippi farmers and because of the need for localized information on this relatively new crop, the Mississippi Station has been carrying on cultural and breeding experiments for several years. The varieties grown now in the state are the National Association Pickling and Chicago Pickling, with by far the greater acreage being planted to the former. Both these varieties were developed by breeding and selection work by northern experiment stations, under northern climatic and soil conditions. They are not as well adapted to south-

TABLE 1—DISTRIBUTION, ACREAGE, AND VALUE OF CUCUMBERS GROWN FOR PICKLING, AVERAGE 1927-36, AND 1937 AND 1938

	Acreage			Value		
STATE	Average 1927-36	1937	1938	Average 1927-36	1937	1938
	Acres	Acres	Acres	Dollars	Dollars	Dollars
Michigan	21,540	29,000	22,700	684,740	1,278,900	1,055.240
Wisconsin	10,100	17,000	8,400	370,840	622,200	388,200
Indiana	7,450	7,500	6,500	232,000	278,160	186,030
Ohio	4,480	6,000	6,500	194,560	170,820	223,080
New York	3,750	3,100	1,050	297,750	219,480	64,000
Minnesota	2,600	2,500	900	61,000	119,180	33,000
Virginia	2,370	4,600	5,200	115,050	228,160	215,340
California	2,330	2,720	1,960	233,750	353,400	265,440
Iowa	1,950	3,260	1,200	54,600	133,320	28,620
Illinois	1,800	1,400	830	69,600	79,560	38,160
Maryland	1,600	1,600	1,960	75,040	76,800	84,780
Colorado	1,730	1,860	1,200	102,000	183,840	96,720
Texas	1,480	4,800	4,000	39,200	108,000	121,000
Missouri	1,470	2,200	1,060	27,520	112,500	22,790
North Carolina	1,400	5,670	4,700	76,450	250,750	219,700
Other States*	10,970	16,840	14,480	495,660	522,340	576,810
TOTAL	77,020	110,070	82,640	82,640	5,109,060	3,828,500

*Mississippi and 21 other states.

ern conditions as to those of the north, nor are they as good as is needed for the south.

Better Variety Sought

An effort is therefore being made at State College to develop by a carefully followed program of breeding and selection a variety that is better suited to Mississippi conditions, is more disease resistant, and equally as good for pickling as the varieties now grown.

In 1938 ninety-eight strains of "breeding lines" were planted. These were mostly inbred selections obtained from the Bureau of Plant Industry. They were chosen for testing because of their resistance to either bacterial wilt or downey mildew, or because of the greener color of their fruits. The National Association Pickling variety was included because of its commercial importance in this state.

Seed were produced in 31 crosses in 1938, principally between National Association Pickling and vigorous or disease-resistant lines. With the cooperation of the Bureau of Plant Industry making possible the growing of the first generation seed in the greenhouse, the second generation of these crosses was grown at State College in 1939. Nineteen selections were made during that year, and self-pollinated seed produced from them. In 1940 the third generation of these selections was grown as well as 6 additional selections obtained from the Bureau of Plant Industry because of the dark green color of their fruit. Further study was made of the character of the fruit and vigor and disease resistance of the plants in these selections. Thirteen individual plant selections were made this year, and two of these were back-crossed to a great grandparent.

Because a variety is needed which is resistant to nematode attacks, those varieties and selections that show disease resistance and vigor at State College are

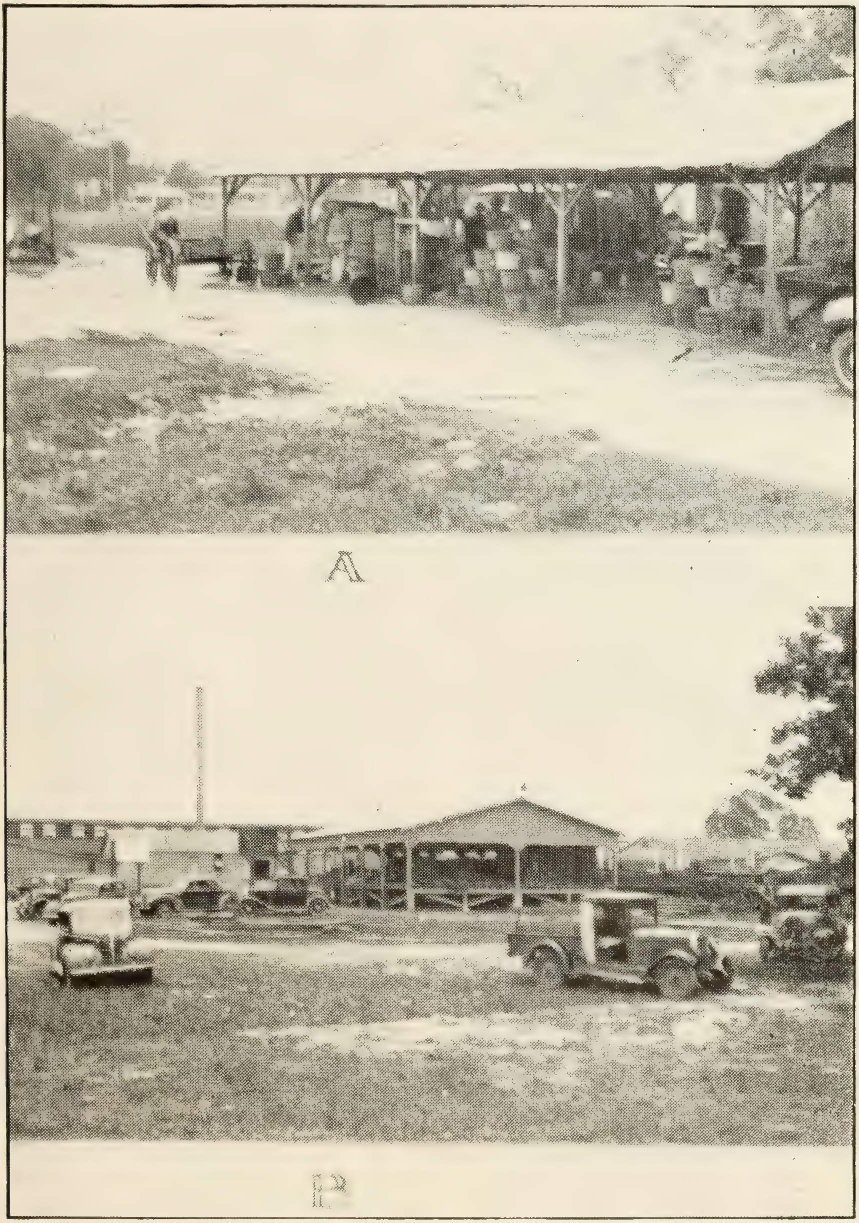


FIGURE 1—Receiving and grading sheds where pickle packers receive, grade and pay growers for their crop. (A) Typical receiving shed away from factory; (B) Typical receiving shed at pickle factory.

also grown on nematode infested soil near Wiggins and observed for their resistance to this pest. A few, although mostly unfruitful, have withstood nematode attacks and continued growth for several weeks after all plants of the National Pickling variety were dead of diseases and nematodes.

Since considerable time is required for the selection work involved in developing a new variety by breeding, nothing new is yet available. It is believed, however, that much progress has been made and that in the near future an improved variety will be available.

Fertilizer Experiments

Cultural experiments by this Station consist mainly of tests of different fertilizer treatments. These have been carried on with the cooperation of the Widlar Division of Standard Brands, Inc., Wiggins, Mississippi, pickle manufacturers, and their contract growers in that vicinity. The recommended practices for growing cucumbers given in this bulletin are based upon results obtained from these experiments and those conducted by other stations wherever pickle production is practiced in the southern states, and upon the long experience of successful growers. The information is intended to be of practical benefit to the growers and packers of cucumber pickles in Mississippi.

CUCUMBERS RESPOND TO ADEQUATE FERTILIZATION

The cucumber plant is not a gross feeder, but in order to obtain most profitable returns a vigorous growth of vines must be maintained. A soil well supplied with organic matter contributes greatly to that end. However, the soils on which most of the state's pickling cucumbers are grown are the poorer soils that are sandy and lacking in organic matter.

The response of this crop to organic matter applied to light soils is seen in the results of many experiments through out the country. In one series of 12-year-old tests the Ohio station obtained an increase of 82 percent in yield over no fertilizer from 16 tons of manure, and an increase of 21 percent from 1220 pounds of 4-10-4 fertilizer. Rhode Island tests show simliar results. In Michigan it is recommended that 10 to 15 tons of manure and 300 pounds of superphosphate be broadcast in early spring before plowing the land.

Potash Needed On Old Land

The kind and amount of fertilizer most profitable for pickle cucumber production depends, of course, upon the character of the soil, its previous treatment, and its present fertility level. In table 2 the results of experiments with fertilizers for cucumbers by this Station in 1938 are shown. The tests were on a Ruston fine sandy loam soil that had been growing crops of corn, cotton and various truck crops for many years. The field was level and fairly uniform in apparent fertility. Table 2 shows that good total yields were obtained on most plots that received 800 pounds to the acre of a complete fertilizer. A total of 20 pickings were made from the plots, beginning June 1 and continuing at approximately 2-day intervals until July 5. The "profits to the acre from fertilization" shown on this and other tables, was calculated by deducting from the total receipts, based on the contract price paid to growers, the farm cost of home-mixed fertilizer. This seems to be a fair method for comparing the fertilizer treatments, but takes no account of the cost of extra labor required to harvest the higher yields.

The data show variations in the pro-

TABLE 2—CUCUMBER FERTILIZER RESULTS, 1938

Ruston fine sandy loam soil—long in cultivation

Fertilizer	Percent of grades No. 1	No. 2	No. 3	Total pounds to the acre	Profits to the acre from fertilizer
VARYING NITROGEN: 800 lbs. TOTAL FERTILIZER					
2-8-8	27.1	53.8	19.1	7759	$45.48
4-8-8	26.9	55.8	17.3	8417	48.39
6-8-8	25.7	52.0	22.3	8522	45.64
8-8-8	28.5	50.8	20.7	8911	48.76
VARYING PHOSPHORUS: 800 lbs. TOTAL FERTILIZER					
6-4-8	27.4	53.1	19.5	7463	41.49
6-8-8	26.9	54.1	19.0	8787	48.85
6-12-8	25.5	53.6	20.9	8886	46.65
6-16-8	26.2	51.4	22.4	10645	57.20
VARYING POTASH: 800 lbs. TOTAL FERTILIZER					
6-8-0	28.0	39.6	32.4	4343	20.39
6-8-4	29.5	50.7	19.8	8339	48.64
6-8-8	33.8	49.0	17.2	7061	43.77
6-8-12	28.9	51.0	20.1	7632	39.28
6-8-16	31.1	49.5	19.4	8709	48.58
VARYING RATES OF 6-8-8					
500 lbs.	30.9	47.4	21.7	7435	45.45
1000 lbs.	32.3	51.2	16.5	9702	57.01
1500 lbs.	31.5	50.7	18.8	12872	72.15
2000 lbs.	31.7	53.3	15.0	13241	67.15

portion of the grades of pickles from the various fertilizer treatments, but the only significant difference was among the potash treatments.

Omitting potash from the fertilizer greatly influenced the grade, yield and profit on this soil. There was little or no difference in the percentage of No. 1 cucumbers from any of the treatments, nor in the percentage of No. 2 cucumbers between the plots receiving potash. There was, however, a much smaller percentage of No. 2 and a much larger percentage of No. 3 from the 6-8-0 (no potash) treatments than from those receiving potash.

This difference is important and greatly influenced the financial returns. Growers receive, in general, three times as much for one hundred pounds of No. 1 as for No. 2 and twice as much for No. 2 as for No. 3. Indeed, frequently the packers do not contract to take the

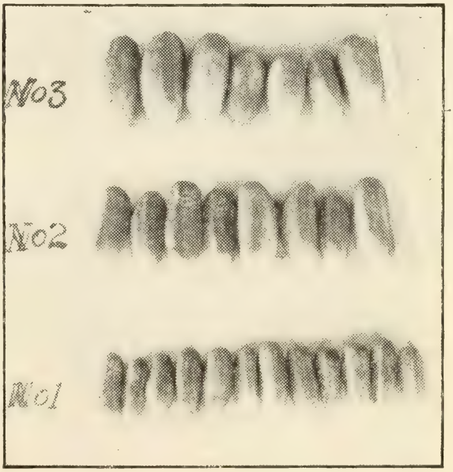


FIGURE 2—The 3 grades of pickling cucumbers usually accepted by packers in Mississippi: No. 1—Sound straight and crooked pickles not exceeding 1 inch in diameter. No. 2—Sound straight and crooked pickles not exceeding 1½ inches in diameter. No. 3—Sound straight pickles not exceeding 5½ inches in length and 1¾ inches in diameter.

TABLE 3—CUCUMBER FERTILIZER RESULTS, 1939

Ruston fine sandy loam—First year cultivated

Fertilizer	Percent of grades No. 1	 No. 2	 No. 3	Total lbs. to the acre	Profits to the acre from fertilizer
VARYING NITROGEN: 800 lbs. TOTAL FERTILIZER					
2-8-8	22.5	60.3	17.2	7610	$58.45
4-8-8	25.4	48.8	15.8	10392	83.88
6-8-8	24.6	57.8	17.6	11505	90.59
8-8-8	23.6	56.6	19.8	12709	97.48
VARYING PHOSPHORUS: 800 lbs. TOTAL FERTILIZER					
6-4-8	24.2	59.3	16.5	9964	78.51
6-8-8	23.4	62.6	14.0	10026	77.50
6-12-8	22.2	64.8	13.0	13184	102.79
6-16-8	24.2	59.7	16.1	10798	81.56
VARYING POTASH: 800 lbs. TOTAL FERTILIZER					
6-8-0	20.2	64.7	15.1	13729	101.11
6-8-4	20.8	63.2	16.0	13276	103.31
6-8-8	20.0	64.9	15.1	12037	90.97
6-8-12	21.6	64.5	13.9	14497	113.29
6-8-16	22.6	63.8	13.6	12782	98.42
VARYING RATES OF 6-8-8					
500 lbs.	22.4	58.4	19.2	10732	85.10
1000 lbs.	19.5	61.5	19.0	16523	123.44
1500 lbs.	22.0	60.9	17.1	16918	126.19
2000 lbs.	20.9	63.0	16.1	17052	118.32

No. 3 grade except from growers who live near enough to deliver the daily pickings directly to the factory. Figure 2 shows cucumbers of the three grades referred to in this bulletin.

In net profit, there were no differences of importance among the nitrogen treatments or among the phosphorus treatments. In the potash treatments, all were more profitable than the no-potash plot, which showed a profit of only $20.39; but there was little gained by using more than 4 percent potash on this field. The 4 percent potash showed a profit of $48.64, the 16 percent almost the same, $48.58; but the 8 percent and 12 percent showed profits of $43.77 and $39.28 respectively. In the rates of 6-8-8, the 1500 and 2000 pound treatment were each decidedly more profitable than 500 pounds, but the 1000 pounds only slightly exceeded the 500-pound application. Figure 3 shows plots receiving potash and no potash treatments in the 1938 experiments.

Nitrogen Needed On Newground

The 1939 data, shown in table 3, was obtained from a planting on a new field of Ruston fine sandy loam soil. This field had not grown crops before, and proved to be much more variable in natural fertility than was thought at the time it was chosen for the experimental plots. On the whole, however, good yields were obtained. Pickings were made about every 2 days from May 30 to June 30.

Again, as in 1938, the results show some variation in grade proportions and in total yields among the various fertilizer treatments. The only significant differences were in the different nitro-

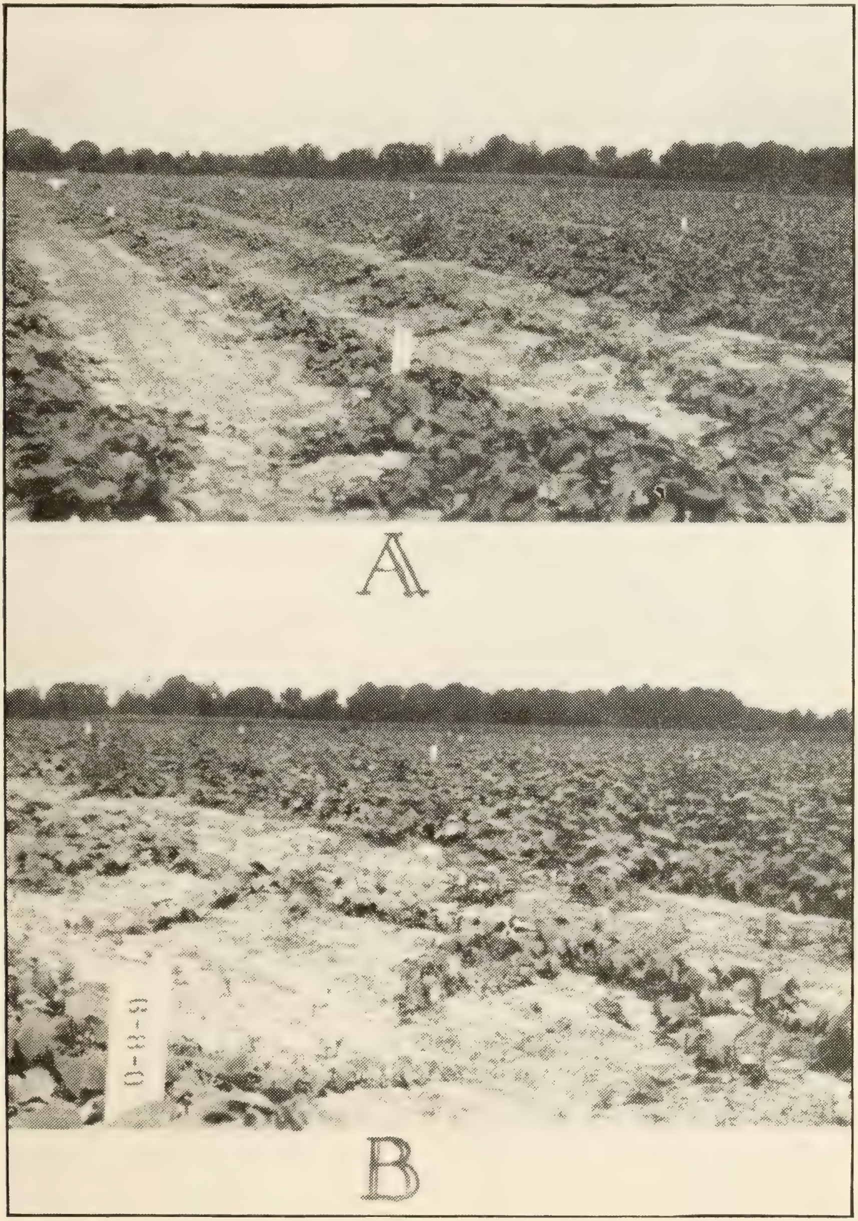


FIGURE 3—Views in potash block of 1938 fertilizer experiments. (A) Left, 800 lbs. 6-8-0; right, (stake not shown) 800 lbs. 6-8-4; (B) Left, 800 lbs. 6-8-0; right, 800 lbs. 6-8-12.

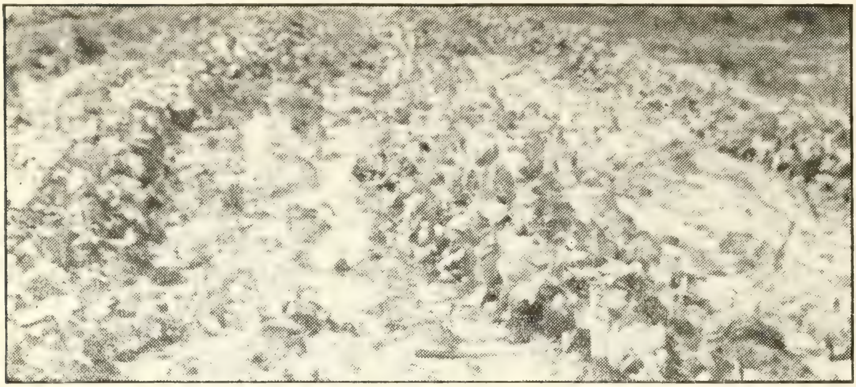


FIGURE 4-A—View in nitrogen block of 1939 fertilizer plots: 800 pounds 2-8-8.

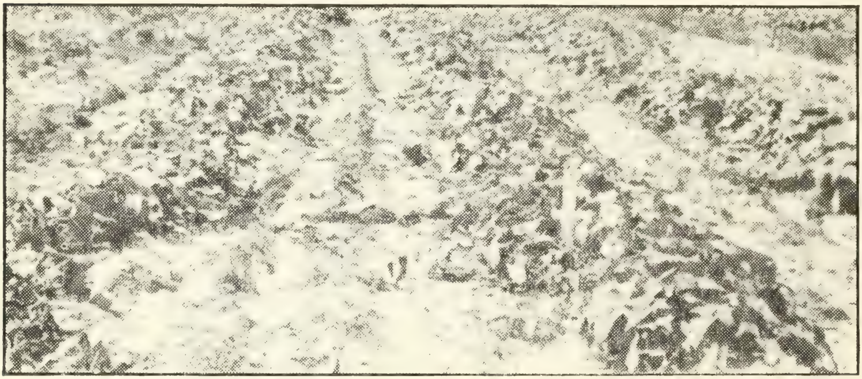


FIGURE 4-B—View in nitrogen block of 1939 fertilizer plots: 800 pounds 6-8-8.

gen applications. Profit from the 4 per cent nitrogen treatment was considerably higher than from the 2 percent nitrogen treatment, but the 6 percent treatment was not better than the 4 percent, nor was the 8 percent treatment better than the 6 percent. Increased profit would be expected from higher rates of 6-8-8 than 500 pounds in this field, but there was such variability in the plots of the rates test that no significant difference were found in the average results. Apparently this field of new soil contained sufficient phosphorus and potash but not enough nitrogen for a cucumber crop.

Figures 4 and 5 show plots in the nitrogen and rates blocks, respectively, of the 1939 tests.

Inconclusive Results In 1940

The data for the 1940 experiments, shown in table 4, were obtained from a planting on a new field of Ruston fine sandy loam soil, very similar to the soil used for the 1939 plots. Twelve pickings were made at regular 2-day intervals from June 11 to July 9. Due to excessive rainfall during the harvest period in 1940, the pickings were light, and the length of the fruiting season and therefore the total yield, were greatly reduced. Growers estimated that they made

TABLE 4—CUCUMBER FERTILIZER RESULTS, 1940
Ruston fine sandy loam—First year cultivated

Fertilizer	Percent of grades No. 1	No. 2	No. 3	Total lbs. to the acre	Profits to the acre from fertilizer
VARYING NITROGEN: 800 lbs. TOTAL FERTILIZER					
2-8-8	38.9	42.1	19.0	2576	$29.87
4-8-8	43.2	44.8	12.0	2422	28.18
6-8-8	42.5	42.5	15.0	2323	24.23
8-8-8	40.0	46.1	13.9	2921	30.85
VARYING PHOSPHORUS: 800 lbs. TOTAL FERTILIZER					
6-4-8	40.5	43.2	16.3	2285	13.38
6-8-8	42.4	42.4	15.2	2290	13.47
6-12-8	41.0	44.9	14.1	2952	17.78
6-16-8	43.3	42.7	14.0	3077	19.29
VARYING POTASH: 800 lbs. TOTAL FERTILIZER					
6-8-0	35.9	42.8	21.3	2698	18.21
6-8-4	40.8	45.6	13.6	2920	21.11
6-8-8	39.8	45.1	15.1	3128	21.60
6-8-12	44.7	41.0	14.3	2760	17.88
6-8-16	39.7	42.8	17.5	3213	19.68
VARYING RATES OF 6-8-8					
500 lbs.	38.8	42.9	18.3	2577	19.21
1000 lbs.	38.6	42.4	19.0	3495	21.89
1500 lbs.	35.3	48.7	16.0	2755	16.95
2000 lbs.	40.0	45.0	15.0	4036	15.09

less than half of a normal crop. For this reason, no significant differences occurred among fertilizer treatments which might have differed in a normal season. The table shows the proportion of grades, the total yields, and profits for the various treatments.

RECOMMENDATIONS FOR CULTURE OF PICKLE CUCUMBERS

Since the production of pickle cucumbers is a comparatively new agricultural industry in Mississippi, it is thought that a brief review of good cultural practices may be helpful. Therefore, in the following pages, recommendations and suggestions are made on type of land, land preparation, fertilization, varieties and seed planting and thinning, cultivation, pollination, harvesting, and insect and disease control.

Type of Land For Cucumbers

While pickling cucumbers are grown on many different soil types, only the better soils can be depended upon to give maximum yields of well-formed cucumbers. Most growers plant on sandy loam or clay loam soils well supplied with organic matter and in good physical condition. However, good yields are often obtained from the lighter type sandy loam and sandy soils. In the area of South Mississippi where most of the cucumbers are now grown in the state, the lighter sandy soils that have been in cultivation for some years are likely to be infested with root-knot nematode. For this reason the better growers try

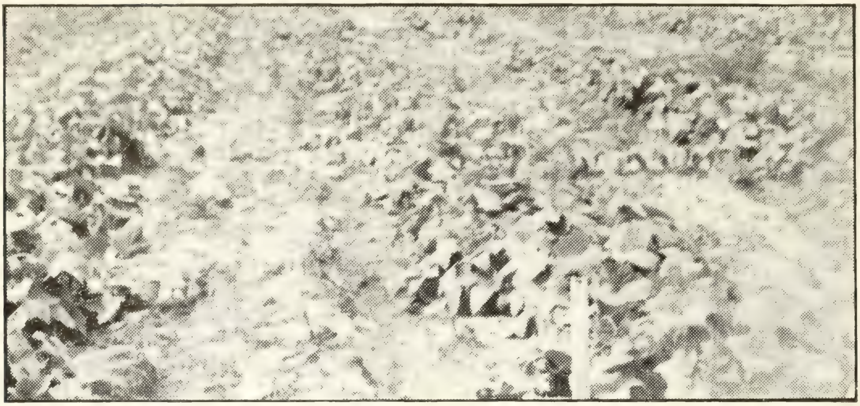


FIGURE 5-A—View in rates block of 1939 fertilizer plots: 500 lbs. 6-8-8.

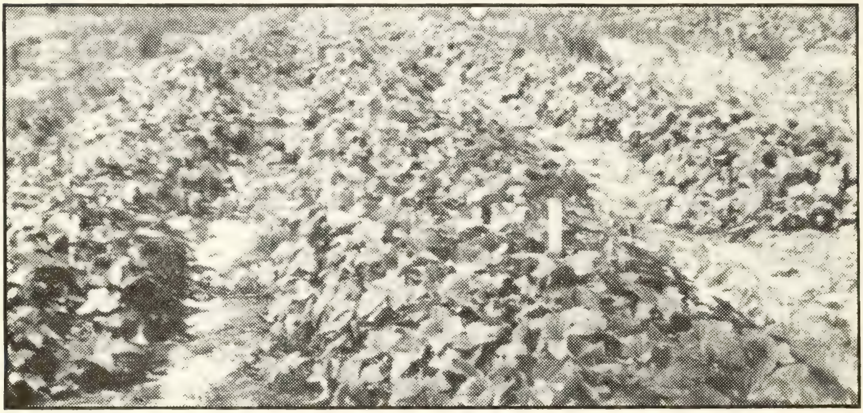


FIGURE 5-B—View in rates block of 1939 fertilizer plots; 1500 pounds 6-8-8.

to select either new soil or fields of old soil known to be free of nematode. Because bottom lands are more subject to frost damage, a soil with a rolling topography giving food air drainage is preferable. Cucumbers should not be planted on land that has been recently used for muskmelons, pumpkins, squashes or cucumbers, because serious damage may result from ravages of insects and diseases. A winter legume is a good crop to precede a cucumber crop, provided it is plowed under 2 or 3 weeks before cucumber planting, so that the crop can be completely decomposed.

Land Preparation

Preparation of the land for growing cucumbers should be the same as for most garden or truck crops, that is, very thorough in all phases. Fall plowing should be done where applications of manure are made in the fall but the land should not be left bare during the winter, because of the likelihood of erosion. The final preparation, with the commercial fertilizer application, should be made about a month before planting. At this time the soil should be thorougly disked and harrowed, with the fertilizer being mixed with the top soil in a space at least a foot wide along the row. Small ridges should be prepared and smoothed with a board drag for planting.

Because of the general practice of growing cucumbers on new land, thorough preparation cannot be over emphasized. Entirely too much trash and rubbish usually is left on new fields, and in general they are not thoroughly plowed and harrowed. All coarse trash should be raked up and burned or removed from a new field before plowing.

800 or 1000 Pounds Fertilizer

Apparently, growers should apply 800 to 1000 pounds to the acre of 6-8-4 to the average new land. If a winter legume is turned under, probably 4-8-4 would prove satisfactory. When planting is on old land that has been cropped heavily and not highly fertilized or manured in the previous few years, a 6-8-8 mixture should be used. If 10 to 15 tons of manure are broadcast, the commercial fertilizer application may be reduced to 400 or 500 pounds to the acre. In any case, a very serious deficiency of nitrogen in the soil can usually be noticed fairly early in the growth of the plants, and in such instances a side dressing of about 100 pounds to the acre of nitrate of soda or ammonium sulphate can be made.

Varieties and Seed

Only varieties of cucumbers specifically adapted for pickling should be planted for commercial pickling purposes. Packers have long since learned this fact, and where growers produce cucumbers under contract with the packers, the seed are supplied to the growers by the packers free or sold to them at a nominal price. Thus the packers usually have control of the variety requirement and source of seed supply. Growers should insist, however, that the seed furnished them are true to type for the variety specified, and that they are good seed so that good germination and good stands can be expected. Shortly before planting, the seed should be treated for 5 minutes in a 1-to-1000 corrosive sublimate solution, washed in clear water and dried. This is a wise precaution that helps in the control of certain diseases, especially angular leaf spot. Most packers who supply the seed for their growers, furnish seed that already have been treated.

Planting and Thinning

Cucumber plants are highly susceptible to cold injury or frost damage and the crop should not be planted until all danger of frost is past. Growers usually know the average date of the last frost in their community. They should not plant cucumber seed until after that date has passed. Mississippi growers frequently lose their seed and the labor of planting by planting a week or so too early. The seed seldom germinates when the temperature is below 50 degrees F. and best germination is obtained at temperatures above 70 degrees F. The best practice is to wait until the seed will germinate quickly and the plants grow off fast, rather than to run the risk by too early planting, of having poor stands of plants stunted by cold.

Planting distances vary, but in general pickling cucumbers are planted in rows about 6 feet apart, with the hills spaced 2 to 3 feet apart in the row. Sufficient data is not available on spacing cucumbers and the relationship between fertilizer rate and spacing for more than general treatment here. Under the average conditions, however, it seems that the 6-foot row width and 2½-foot spacing between hills will give satisactory results. Several seeds should be planted in each hill, by using a hoe or using a mechanical planter, and covered with an inch of soil. When the seedlings have four to six leaves the first thinning should be done by cutting off the weaker plants just above the soil surface, leaving 2 or 3 plants to the hill at this thinning. Later when the plants start to run, thin the hills to the final stand.

Most growers prefer to leave one plant to the hill, for when plants are not crowded they frequently make from 15 to 25 strong lateral branches and often yield more cucumbers than are obtained from plants more closely spaced. Furthermore, wider spacings with fewer plants to the hill make cultivation and picking easier. According to some growers finding all of the cucumbers that should be picked as they reach the proper size for pickling, is difficult among thickly planted vines.

Cucumber Cultivation

The most important part of the cultivation of a crop is the careful preparation of the land before planting. If it is thoroughly plowed, disked and harrowed, the only cultivation necessary is that needed to control weeds and grass. The cucumber plant has an extensive root system, but many of its roots are very shallow. For that reason cultivation should not be deeper than about 2 inches, for deeper stirring of the soil will injure the roots and hinder the growth of the plant.

A one-horse spike-tooth or spring-tooth cultivator, operated shallow, is an excellent tool for cultivating cucumber fields. If the vines are carefully turned so as to train them to grow with the row instead of across the row, effective horse cultivation can be continued much longer in the season, thereby insuring better weed control at less labor cost.

Fields of cucumbers should be kept free of weeds and grass even if hand pulling or hoe work is required. Handling of vines, hoeing or cultivating while the plants are wet, should be avoided as much as possible; tools used in cultivation, or the hands or clothing are likely to spread such diseases as mosaic, bacterial wilt, anthracnose, and cucumber scab from diseased to healthy plants.

Bees Required For Pollination

The cucumber has on each plant two kinds of flowers: the male or pollen-bearing flower and the female or fruit-bearing flower. These are shown in figure 6. The male flowers appear first on the plants, often in great abundance; and when these are seen to wither and fall off, it is sometimes thought by some that the cucumbers are failing to set. With the appearance of the female flowers, however, normal fruit production should occur.

The pollen of cucumber flowers is sticky and therefore dependent on insects for its transfer to the female flowers. This transfer, which is essential for fruit development, is usually accomplished by honey bees. Nectar glands are at the base of the flowers, and while the bee reaches for the nectar of the male flower, some of the pollen sticks to the bee's hair. Then, when the bee visits a female flower some of this pollen is brushed on the sticky surface of the center (stigma) of this flower. Fertilization of the flower thus takes place and the tiny cucumber at its base begins to develop. Figure 7 shows a bee collecting nectar from a cucumber flower. Since the cucumber flowers are largely bee-pollinated, the importance of having bees visit the fields daily is apparent.

Heavy pickle production involves almost continuous development of new fruits, and failure to obtain set even for a few days may mean a loss large enough to be the difference between success

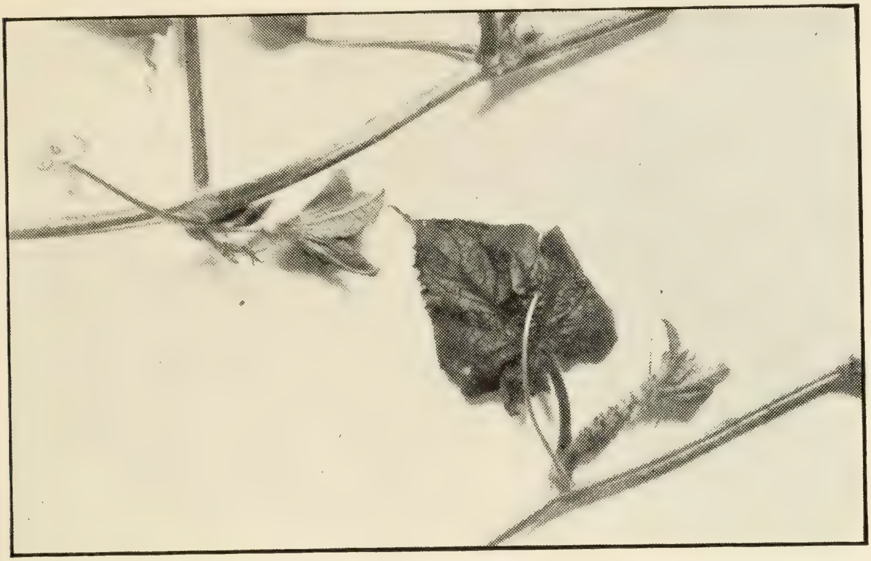


FIGURE 6—Kinds of cucumber flowers. Male flower at top and female flower at bottom.

nd failure. Bees do not travel very far rom the hive during cool, cloudy or showery weather. The proximity of ives to the cucumber fields may influnce decidedly the yields of No. 1 grade ruit. Many experimental results are vailable which show that unsalable 'nubbins," "balls" and "crooks" are roduced largely because of poor pollinaion resulting from inactivity of bees or oo few visits of bees to the fields. For hese reasons, the cucumber fields should ot be further than one-fourth mile from ne or more hives of bees.

Pick at Frequent Intervals

Usually there will be fruits ready for icking in 60 to 70 days after cucumbers re planted. The first picking or two ill barely pay for the labor of harvestng, but for the benefit of subsequent ickings it is important that these few arly fruits be removed. Few growers ealize how much the production of new lowers is reduced by a small number of aturing fruits on a plant. A vigorous growing cucumber plant will mature not more than 5 to 10 fruits in a season. However, if the young fruits are removed before they attain any considerable size, the plant will produce 35 to 50 fruits.

Finding and picking every cucumber on a vine at any one time is difficult but that should certainly be the picker's aim. If any fruits are missed and become too large for use, they should be removed from the vine as soon as noticed.

Pickers should be careful in picking to see that the vines are not injured. If the vines have been trained along the row, and especially if proper distance is allowed in planting, the vines may be virtually "rolled over" and, after the fruits are picked, rolled back into their original position. Because of the saving in labor costs, growers frequently use small children as pickers. When this practice is followed very careful supervision is essential or more will be lost than gained by the saving in outlay for labor.

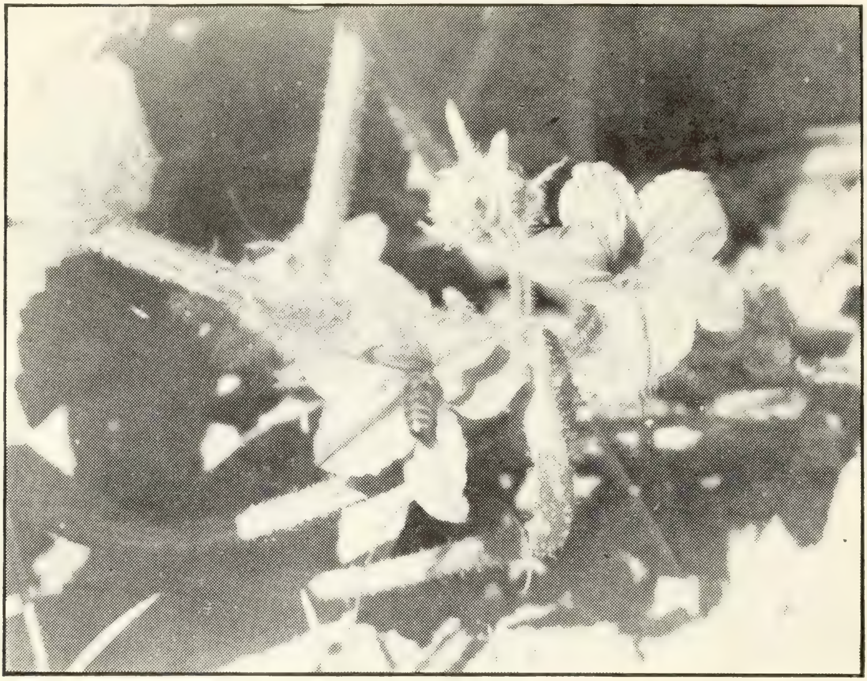


FIGURE 7—Honey bee collecting nectar from a cucumber flower.

Harvesting cucumbers for pickles is usually regarded as the largest outlay of expense in growing the crop, and this is governed largely by the frequency of the pickings. Some packers recommend that pickings be frequent, every 1 or 2 days. The growers want to harvest the crop with as few pickings as possible. With very frequent pickings, small-size fruits are certain to predominate, and the average fruit size will be larger with increasing length of the interval between pickings.

Research workers in Michigan determined that the total number of fruits produced increases with frequent pickings, while the total weights of fruits were greatest from the longer intervals. The percentage of small grade fruits, it was found, increased with frequent pickings, while the increase in percentage of larger size from the longer intervals more than offset this effect. Nubbins and crooks were the same for all picking intervals from 1 day to 7 days.

When the interval between pickings was longer than 4 days, a large percentage of unmarketable culls was harvested. It was shown that financial returns less the estimated harvesting costs, were largest for the 4-day interval and smallest for the 1-day interval. The data indicate that high financial returns depend on large acre yields, and high yields are generally accompanied by a better grade of pickling cucumbers. Under ordinary soil and weather conditions, it is recommended that cucumber fields be picked every 2 or 3 days.

CONTROL OF DISEASE AND INSECT PESTS

The entomology department of the Mississippi Experiment Station is conducting tests for the control of cucumber insects and the following recommendations based on results secured thus far are submitted for the benefit of growers by Clay Lyle, entomologist.

The most important insects attacking cucumbers are the striped cucumber beetle, the 12-spotted cucumber beetle, the pickle worm, and the melon aphis or louse. The banded cucumber beetle is sometimes abundant enough to cause damage, but is not generally as numerous as the other two species.

Cucumbers grown for pickles are usually harvested before much damage can be done by the pickle worm, but the beetles may often destroy a crop soon after it comes up. The best control found thus far is a derris dust containing one-half to three-fourths percent rotenone, applied at weekly intervals as long as the beetles are numerous, or more often if the beetles are present in extremely large numbers. The carrier for the derris should be talc or clay as sulphur which is often used with derris on beans and other crops, is injurious to cucumbers and cantaloupes. The prepared mixture is available in most large towns in Mississippi. If the derris dust cannot be procured easily, a mixture of one part calcium arsenate and 9 parts talc or hydrated lime will give fair results.

Frequent examinations should be made on the under side of the leaves and in the buds for melon aphids or lice, although these are not likely to cause any damage where derris dust is applied regularly for beetle control. Lice usually appear first on only a few plants and prompt treatment of these spots will prevent spread to the remainder of the field. Thorough spraying with 2 teaspoons nicotine sulphate (Black Leaf 40) in a gallon of water in which an inch cube of soap has been dissolved, using an angle nozzle to reach the lice on the under side of the leaves, should give good results.

Although no separate experiments were conducted for disease control, it was found that the plots which received the insect control treatments containing copper remained green and vigorous longer than those which received no copper. In tests at Wiggins in 1939 beetles were not abundant enough to cause any damage and the plots receiving copper made the highest yields. A talc dust containing one-half percent to three-fourths percent rotenone and 5 percent of a copper oxychloride compound (such as Grasselli Copper Compound) has given good results and seems to be a very satisfactory combination dust. A mixture of 5 percent basic copper arsenate and 95 percent talc also has possibilities for both insect and disease control. Tests of all these materials are being continued.

Bulletin No. 356 *July, 1941*

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PASTURES IN *Mississippi*

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
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CLARENCE DORMAN, DIRECTOR

SUMMARY AND RECOMMENDATIONS

Pastures are becoming increasingly important in Mississippi agriculture. This is shown by the number of plowable acres put to pasture in the past ten years.

The value of pastures is shown as a cheap source of feed, the use of which results in increased efficiency of animal production and in soil conservation.

Soil fertility and the location of the pasture so as to fit in with other farming operations are the main factors to consider in the selection of pasture land.

The amount of soil preparation necessary varies with the condition of land, the preceding crop, desirable crops growing, and the amount of noxious plants present. Any preparation should eliminate obstructions to the use of farm machinery, especially the mowing machine.

The plants most commonly used in Mississippi pastures and methods of establishment are discussed. It is recommended that the grass base be established first, followed by the seeding of pasture legumes, as:

8 to 12 pounds of Dallis grass per acre seeded in early fall,
10 to 15 pounds of Lespedeza per acre seeded in early February,
2 to 4 pounds of White Dutch or Hop clover seeded the following fall.

It should again be emphasized that all plants should be allowed to become firmly established before utilization begins. Graze lightly the first season.

Pasture improvement by means of timely mowing and proper fertilization results in the production of more grazing material which is of a higher quality and more palatable. Both practices make conditions more favorable for the growth of desirable pasture plants. The use of these practices also tend to cause a more even production throughout the grazing season.

Fertilization should be for the benefit of pasture legumes. For the Brown Loam and Prairie regions this is best done by the application of 200 to 400 pounds of superphosphate or 500 to 800 pounds of basic slag per acre per year. For the infertile soils of the Coastal Plains, 100 pounds of potash should be included in this mixture. Liming should be applied at the rate of 500 to 1000 pounds every fifth year.

After the establishment of pastures, the most important factor in pasture management is the prevention of overgrazing. This can best be done by the use of supplemental grazing crops. The value of returning animal manures to the soil as a pasture management practice is shown.

The seeding of desirable plant mixtures which are allowed to become fully established, the application of the practices of timely mowing and proper fertilization, and the prevention of both undergrazing and overgrazing will result in comparatively high producing and efficient Mississippi pastures.

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Pastures In Mississippi

A Preliminary Report

By H. W. BENNETT, Associate Agronomist

Pastures have received less attention than any other major phase of Mississippi agriculture. This lack of attention has principally been due to the one-crop system of farming so long practiced in the state. Such a system has caused agronomic research to be chiefly concerned with the varieties, the cultural practices, and the rates and analyses of fertilizer applications for the crops grown.

However, in recent years the agricultural conservation program, problems in land utilization, reduced prices for products of crop land, the demand for erosion control, and more especially the increased interest in production of livestock and livestock products, have caused more attention to be given to pastures.

That more attention is being given to pastures by state farmers is shown by the agricultural census report of 1940. This report shows that in the last ten years there has been an increase of 1,206,896 acres of plowable land put to pastures. Pastures now account for 2,702,190 of the state's 10,702,733 acres of land available for crops, or slightly more than twenty-five percent of the plowable acres of the state. Not included in these figures are those acres which are classed as "woodland" or "other" pastures.

The increased interest in pastures has caused an increased demand for information concerning pastures. Although considerable investigational work has been done on pastures, with promising results to date, the very nature of the problem necessitates that tests be conducted over a long-time period to be conclusive. The immediate demand for pasture information, however, makes desirable the publication of this preliminary report on pasture investigations by the Mississippi Station.

It should be kept in mind that the suggestions and recommendations herein reported are based on preliminary findings, and that as more work is conducted these may change. Especially will this be true with respect to more definite recommendations for specific soil areas of the state.

Value of Pastures

The lowering of the cost of production and the efficiency of production are as important in agriculture as in any other type of industry. In this economic sense, the efficient production of livestock and livestock products is directly related to the production of pastures.

That pasture production plays an extremely important part in the agriculture of Mississippi is shown by the practical results obtained by various departments of the Mississippi Agricultural Experiment Station.

The Dairy Department has conducted many tests which show that no other method of providing feed for livestock offers as great returns as the use of good pastures. Pasture made on eroded land was found to furnish nutrients equivalent per cow per day, to those found in 8.5 pounds of good hay, 25 pounds of silage, and 4 pounds of concentrates. Should a like amount of nutrients be furnished in the form of purchased feed over a period of one year there would be a cost of $42.38. This means that this pasture, in terms of purchased feed, was worth $42.38 per acre. Other results obtained by the Dairy department show that a good pasture alone will provide for animal maintenance and the production of at least 15 pounds of 4 percent milk per cow per day. The matter of maintenance is quite important, as a milking dairy cow requires nearly half the nutrients in the feed she consumes merely for maintaining her body.

The Animal Husbandry Department, in an experiment comparing methods of feeding work mules, has found when mules were allowed to graze only at night and on idle days, that there was a saving of 25 percent in grain and a 50 percent saving in hay consumed as compared with the barn- and lot-fed mules. These results take on considerable value when one considers that a properly fed 1000-pound mule will consume 2 tons of hay and 60 bushels of corn per year.

Other experiments carried on by the Animal Husbandry Department have shown the value of pastures. More pork has been produced per 100 pounds of feed where grain-fed pigs were allowed to graze than when fed on dry lot. It has also been shown that more cottonseed meal, a home-grown concentrate, can be fed to grazing pigs than to pen-fed pigs.

The Poultry Department has found that more eggs are produced, there is less mortality in the flock, and the efficiency of production is increased when poultry is allowed pasturage.

The value of a pasture is almost inestimable when viewed from a soil conservation standpoint. The Agricultural Engineering Department in cooperation with the Soil Conservation Service conducts experiments testing the rate of soil losses under different slopes and cropping practices. A typical example of the results obtained from these tests may be cited. As a result of 24 inches of rain over a period of three months, the amount of soil lost from a 9 percent slope covered with sod was only .08 tons per acre, while a crop-cultivated 7.5 percent slope lost approximately 5 tons of soil per acre during the same period and with the same amount of rainfall. This gives a value to pastures which amounts to huge proportions when one considers the average annual rainfall and the topography of many of the Mississippi pastures.

These examples are given to illustrate the value of pastures, not only from a general farming standpoint, or for the economic production of livestock and livestock products, but also as a means of stabilizing and utilizing the many eroded acres of Mississippi soil, thus enabling the realization of more income and food products than formerly. These examples show, further, that the general-crops farmer, as well as the livestock farmer, needs good pasture for his milk cows, beef cattle, hogs, poultry, and for his work stock in idle times.

Selection of Pasture Land

Soil fertility is probably the most important factor to be considered in the selection of land for pasture. Like other crops, pasture plants can produce only in proportion to the productive capacity of the soils upon which they are grown. Land that is too poor to produce crops will cause disappointment if put to pasture. Most of the bottom land can be made into excellent pastures provided adequate drainage is given. In many instances it may be advisable to remove unproductive timber, briars, and shrubs to provide pasturage in low fertile bottoms and put back to trees or other permanent vegetation many of the infertile, steep lands now in pasture.

Soil fertility affects not only quant

ity of production, but the quality of pasture forage production as well. The same species of plants grown on soils varying in fertility will vary in amounts produced in proportion to the degree of fertility, and will vary also in the chemical composition of the forage produced. As for example, Bermuda grass and lespedeza clippings grown on infertile Norfolk soil contained 8.5 percent protein, 0.41 precent calcium and 0.09 percent phosphorous. Clippings of these same species grown on fairly fertile Grenada soil contained 11.6 percent protein, 0.67 percent calcium and 0.15 percent phosphorous. White Dutch clover grown on Norfolk soil contained 20.5 percent protein and 1.25 percent calcium, while White Dutch on Grenada soil contained 23.7 percent protein and 1.68 percent calcium. The effect of fertility on the quality of production is shown significantly by fertilizer treatments applied to pastures on the same soil, resulting not only in increased yields but also in increased mineral content of the pasture plants which amounts to a doubling in many cases (see table 17.) It must be kept in mind that the same soil type may vary widely in fertility and production capacity.

From data obtained on both the quantity and quality of herbage produced it can easily be said that good land produces good pasture.

Other factors are to be considered in the selection of pasture land. The individual farmer must make the selection of land as it fits in with other farming operations, the location of water supply, and the convenience to the barns in case of pastures for dairy cattle and work stock.

Preparation of Land For Pastures

The amount of soil preparation necessary in pasture making will vary according to the condition of the land, the preceding crop, desirable plants already growing, and the amount of noxious plants present.

If the land is not open it should be cleared of trees which are not needed for shade or erosion control, and of bushes, briars, and shrubs. Such vegetation should be cut low enough to permit the use of machinery on the area; much cut-over land could be made more profitable merely by clearing and ridding of stumps so that mowers and rakes could be used.

Should land that is to be put to pasture have slope enough to be subject to erosion, means should be provided for erosion control. Such structures as terraces and diversions should be constructed that will satisfactorily break up any excessive accumulation of water and divert this water to natural drainage areas or into well-vegetated areas. The construction of mechanical structures is more important on land to be seeded, as it prevents the movement of seed by flowing water and the starting of gullies before the soil is covered with pasture plants. When converting previously terraced fields to pasture, the terraces and the row system should be reworked so that all rows are on a contour and the furrows are shallow enough to allow mowing.

Proper drainage is often as important as erosion control measures. Especially is this true of the Delta and Prairie sections and of fertile bottoms in other sections of the State. Many Prairie pastures contain seepage areas which may be drained by means of terraces, in which case the terraces serve a two-fold purpose.

Much land to be converted into pastures may have varying amounts of desirable plants growing. Thus, common lespedeza may be found throughout the Brown Loam area, or Hop clover throughout the Prairie. Plowing such land would eradicate these plants, and money and time could be more profitably spent in eradicating noxious plants so as to promote the growth of the desirable plants already established and incorporating other species desired, than in soil preparation. Plowing should be done where there is such a dense growth of undesirable weeds or other plants that pasture plant seed sown might not come into contact with the soil. Soil that is caked or too hard for root penetration should be loosened by plowing or disking.

In cases where soil preparation is made, it should be done far enough in advance of planting for the seed-bed to become firm. All experimental evidence points to the necessity for seeding on a firm seed-bed. In any case, whether with much or little soil preparation, prerequisites for pasture development include elimination of obstructions so that farm machinery may be used, and the planting of pasture plant species on a firm seed-bed.

LIMITED NUMBER OF PASTURE PLANTS RECOMMENDED

Early pasture recommendations of the Mississippi Agricultural Experiment Station included a large number of widely varying species of plants. Later investigational work has shown that after several years of pasturing there remains a relatively small number of species to furnish grazing, although seed of many different plants may have been sown. It is for this reason that mixtures recommended for seeding pastures are simple rather than complex, containing but few species, with exceptions for specific cases. Seed of species now recommended demand the highest prices, but this is due to the fact that such mixtures produce the best and most economical pastures and are valued accordingly. Most of the species recommended do best on soils of a higher fertility than the majority of the Mississippi soils which have been put to pasture.

A state-wide recommendation for pasture mixture is as follows: Dallis grass (Paspalum dilatatum), Bermuda grass (Cynondon dactyton), White Dutch clover (Trifolium repens), and Common Lespedeza (Lespedeza striata). Certain changes may be made for variations in soil fertility, soil moisture, and seed price. For example, Black Medic (Medicago lupulina) or Korean lespedeza (Lespedeza stipulacea) may be substituted for common lespedeza on Houston soil of the Prairie; and Alsike clover (Trifolium hybridium) for White Dutch in certain areas of the Delta that tend to be wet. Hop clover, either Low (Trifolium procumbens) or Least (Trifolium dubium) may be substituted for White Dutch on soils of low fertility where no fertilization is to be practiced.

The plants commonly used for permanent pasture in Mississippi, including those recommended and some species not recommended, will be considered separately.

Dallis Grass

Paspalum dilatatum

Dallis grass—also commonly called Paspalum, Large Water grass, or Knot grass—belongs to that group of grasses which are botanically classified as Paspalum. This genus of grasses is made up of approximately 400 species. Some 35 of these species are of relatively wide distribution in Mississippi. Most of them are coarse and unpalatable to livestock. Dallis grass, however, is very nutritious and is by far the most important of these species.

Dallis grass is a fast growing perennial bunch grass with a deep root system. It produces many basal leaves which, following grazing or drought,

TABLE 1.—THE EFFECT OF CLOVER ASSOCIATION ON THE YIELD OF DALLIS GRASS

	Yields of dry matter per acre on three soils		
Crop	Sarpy	Grenada	Ruston
Dallis grass alone	8910.2	9458.0	7258.9
Dallis grass of the association	7346.9	6978.7	6442.5
Clover of the association	1996.2	1807.5	1866.6
Total yield of the Dallis grass and White Dutch combination	9343.1	8786.2	8309.1

makes a more rapid recovery than any other of our pasture grasses. It is propagated by seed produced on long (one to four feet) upright seed stalks. It grows over a long season, being the first of the summer grasses to begin growth in the spring and the last to be frosted in the fall. In the spring it will furnish good grazing several weeks earlier than Bermuda.

This grass is adapted to a wide variety of soils. It makes its best growth on bottomland soils because of more soil fertility and soil moisture. It will thrive on lower land than Carpet, and will grow higher on the hills. It is more tolerant to excessive soil moisture, and at the same time is more drought resistant, than Bermuda or Carpet grass. It grows well on all soils except the extremely sandy ones.

Dallis grass, being a bunch grass, grows in clumps and will not completely cover the soil with a dense sod. However, this is an advantage in that it makes Dallis particularly adapted to associated growth with other desirable pasture plants, especially the legumes. This may be shown by the results of a greenhouse experiment run on three soils with Dallis grass and White Dutch clover.

Association With Clovers

Used in this test was Sarpy sandy loam, a fertile Delta soil; Grenada silt loam, a medium-fertile hill soil of the Brown Loam area; Ruston sandy loam, a medium-fertile soil of the Coastal Plains. The analysis of the soils used is as follows:

Soil Type	Percent nitrogen N_2	Percent calcium	pH
Sarpy sandy loam	.061	.74	6.5
Grenada silt loam	.101	.32	6.2
Ruston sandy loam	.048	.31	6.1

Two series of plots were used on each of the three soil types. One series of plots consisted entirely of Dallis grass plants. The other series of plots consisted of Dallis grass and White Dutch clover plants growing in combination. This combination contained the same total number of plants, as the grass plots, but one-third of the total number were Dallis grass plants and the other two-thirds of the total number were White Dutch clover plants. For every three Dallis grass plants growing on one series of plots there was one Dallis grass plant and two White Dutch clover plants growing on the series of plots having the grass and clover combination. Thus, each plot on each soil type contained the same number of plants regardless of whether this total number was made up of grass plants alone or of a combination of grass and clover plants.

The yield of dry matter produced per acre of five cuttings is shown in table 1.

Dallis-White Dutch Pasture Yields

From this table it may be seen that the plots containing the grass and clover combination produced more total growth than the plots having the same

TABLE 2.—THE EFFECT OF ASSOCIATED GROWTH ON THE PER ACRE YIELDS OF CRUDE PROTEIN, CALCIUM AND PHOSPHORUS.

	Pounds produced on three soils								
	Sarpy			Grenada			Ruston		
	Crude Protein	Cal-cium	Phos=phorous	Crude Protein	Cal-cium	Phos=phorous	Crude Protein	Cal-cium	Phos=phorou
Dallis alone....	733.0	42.4	22.8	937.7	53.8	28.5	583.3	27.3	20.8
Dallis of the association..	668.2	33.2	22.8	656.9	38.9	15.2	557.4	21.6	19.4
Clover of the association..	351.5	27.8	6.1	370.8	30.9	5.4	316.1	24.9	5.5
Total of the Dallis and Clover combination....	1019.6	61.0	28.9	1027.8	69.8	20.6	873.5	46.5	24.9

total number of grass plants grown alone. Considering the yields separately on the combination plots, it will be seen that the grass plants profited from the associated growth. One-third the number of grass plants, when grown in combination with a legume, produced on Sarpy sandy loam 82.46 percent as much grass material as three plants when grown alone, 73.79 percent as much as three plants grown alone on Grenada silt loam, and 88.75 percent as much as three plants grown alone on Ruston sandy loam. The higher nitrogen content of the Grenada silt loam is reflected in the greater growth of grass when grown alone, and in the lessened increase due to the associated clover growth.

This difference in the grass yield was, however, overbalanced when the quality of the plant material and the total yield of one-third Dallis grass plants plus the two-thirds White Dutch clover combination are considered. The pounds per acre production of crude protein, calcium, and phosphorous are shown in table 2.

From these data it may be seen that the total per acre mineral and crude protein yields of the Dallis grass and White Dutch clover combination were greater than the per acre yields of the same number of grass plants grown alone. The single grass plant productio of crude protein and minerals was higher in those plants grown in associatio with clover than the single grass plan production where grass alone wa grown. One grass plant grown wit clover produced the following percentages of minerals as was produced b three grass plants grown alone:

Soil Type	Crude protein	Calcium	Phos-phorou
Sarp sandy loam....	91.16	78.30	100.00
Grenada silt loam....	70.05	72.30	53.33
Ruston sandy loam..	95.56	79.12	93.27

With one exception these data sho that when grown in association with legume, one Dallis grass plant produc ed over two-thirds as much crude pr tein, calcium, and phosphorous as di three Dallis grass plants when grow without clover. These data show fu ther that the less nitrogen contained i the soil the greater the increase i mineral and crude protein productio by grass plants when grown wit legumes.

Thus is emphasized the desirabl characteristic of Dallis grass grown i combination with other plants—a cha acteristic of value because of a greate per acre yield, and also because of greater per plant production of herbag and mineral composition.

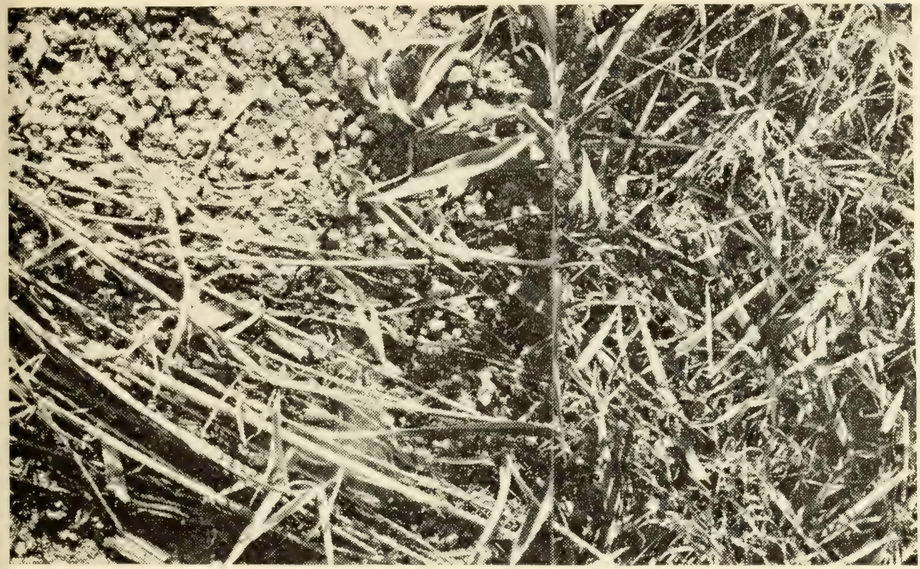


FIGURE 1.—Left: Young Dallis grass plants produced as a result of mulching. Left: The mulch of mowed Dallis forage, as applied. Young plants coming up through mulching material.

Establishing Dallis Grass

Along with these advantages, however, Dallis grass has the disadvantage of being difficult to establish by ordinary methods of seeding. This is due to seed of a low percentage germination and to ineffective methods of seeding. That Dallis grass can be successfully established in spite of low quality seed has been shown by tests of methods of seeding pasture grass conducted by the Mississippi Agricultural Experiment Station.

Seeding eight pounds of domestic Dallis grass seed per acre under varying practices gave the following results:

TABLE 3.—The Effect of the Method of Seeding on the Stand of Dallis Grass.

Method of Seeding	No. plants per sq. foot
Broadcast — No preparation	0.5
Mulched — No preparation	6.0
Prepared — Open furrows	5.0
Prepared — Open furrows — Harrowed	9.0

From the results shown in the table, it may be seen that soil preparation very materially increased the stand of grass, and that the increase in stand was in proportion to the amount of preparation. When seed were slightly mixed with the soil there were nearly twice the number of plants as where planted in open rows without mixing. Preparation by open furrows only was ten times as effective as no preparation. Seeding broadcast, as is ordinarily done, gave only one plant every two square feet. This test shows clearly the advantage of preparation if it be nothing more than a furrow to hold the seed in place.

It should be kept in mind that most pasture grass seed are slow to germinate. The time necessary to obtain an official germination test for Dallis and Kentucky Blue grass is 28 days. Therefore, any method of seeding should provide that the seed should lay where they fall when sown. Herein lies the advantage of mulching, or of

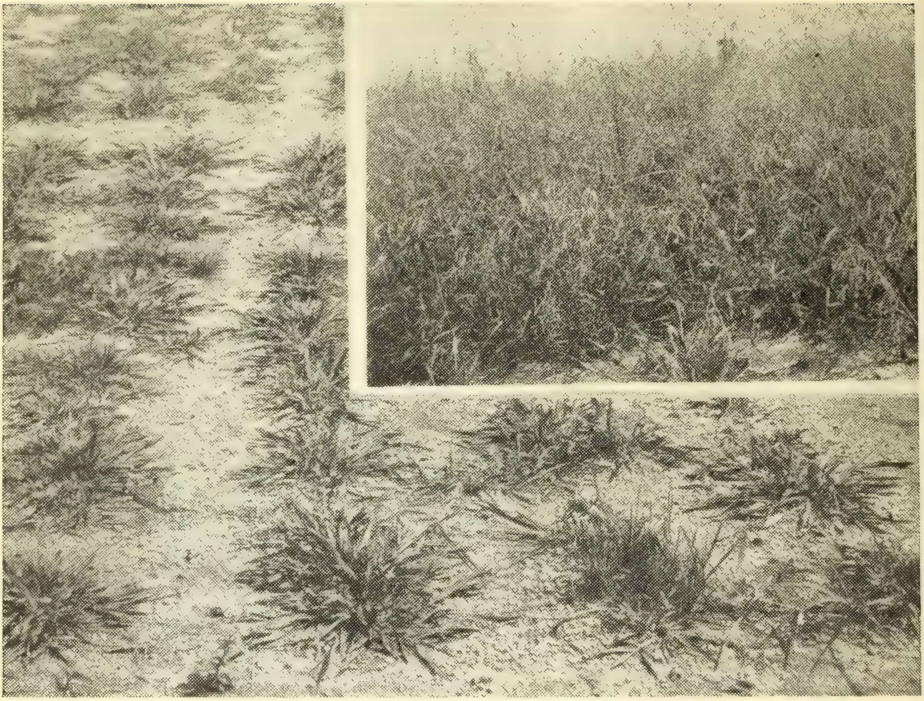


FIGURE 2.—Left: Dallis grass stand resulting from the August seeding of eight lbs. of domestic seed per acre on a prepared seed-bed in August. Right: Same seeding, protected against grazing and weeds until the following July, produced 255 pounds of clean seed per acre at its first cutting.

planting in a furrow, and of lightly covering the seed in the furrow by harrowing.

Probably the most significant result of this work is the stand obtained by means of mulching. Where mulched, there were twelve times more plants than when planted broadcast. This is a very satisfactory method of establishing Dallis grass. Excellent results have been obtained when mulching has been done at the rate of one ton of cut material per three acres. Examples of mulching are shown in figure 1.

Methods of Seeding

Where extreme difficulty in establishment is anticipated or experienced, a practical procedure is to:

(1) Thoroughly prepare an area

(2) Sow 6 to 8 pounds per acre of Dallis grass seed in narrow rows and harrow lightly

(3) Allow to mature seed, and

(4) Mow and scatter the entire mass where Dallis grass is desired, at the rate of 1 ton of the cut material to 3 acres.

The same satisfactory results may be obtained by protecting already existing stands against grazing and weed growth, and mowing and scattering the cut material in the same manner.

Excellent results have also been obtained by sowing 4 to 6 pounds of seed in scooter furrows spaced three to four feet apart and allowing the resulting Dallis grass plants to seed and fall over. In test plots where plants were spaced two feet apart in rows which were three feet apart and allowed to

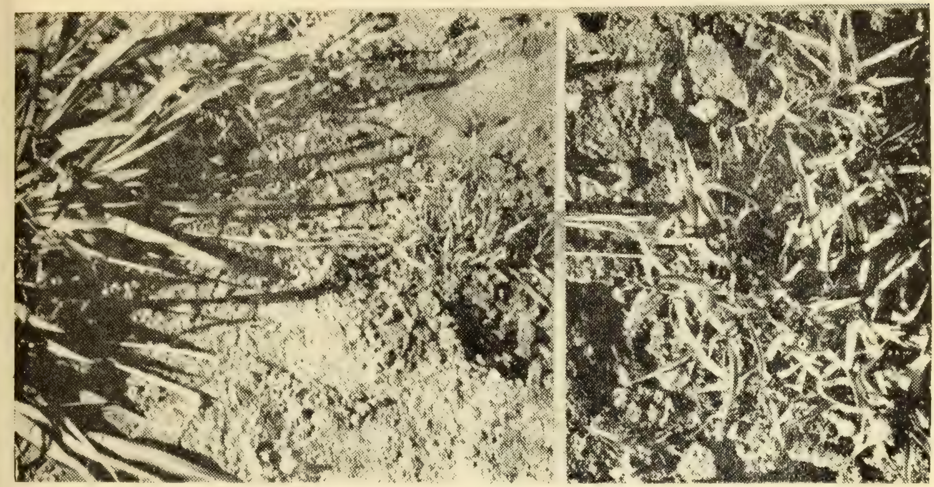


FIGURE 3.—Left: Showing island of young plants produced from seed of two seed-stalks which matured and fell to the ground. Right: A close-up of this island of young plants photographed from directly above, showing dense growth of young plants.

seed, there was produced the next spring a stand of fifteen plants per square foot.

These seeding tests have led to the following recommendations:

1. Where possible, sow Dallis grass on a prepared but firm seed-bed in narrow rows, and lightly harrow.

2. If sowing for the first time on old pasture, run shallow furrows three to five feet apart, and sow seed in the furrow.

3. Where material from a cut-over Dallis grass area is available, mulch new areas where Dallis is desired at the rate of one ton for every three acres.

Dallis grass should be seeded from September to May. Like Bermuda sodding, the supply of moisture is more important than the time of seeding, and early seeding permits the establishment of plants while moisture is usually abundant. Mulching may be done at the time of cutting mature Dallis grass. Under any method of seeding it is extremely important that Dallis plants be allowed to become fully established before heavy grazing or mowing is done A good practice to follow is to allow seed stalks to begin showing before permitting heavy grazing.

Improved Dallis Grass Sought

Dallis grass has long had the reputation of producing an extremely low percentage of seed. So widespread is this idea that domestically produced seed are discriminated against. In an endeavor to determine the extent of seed production and chances of improvement, the Mississippi Agricultural Experiment Station is conducting a breeding project with this species of grass.

Seed from widespread sources were germinated and single plants transplanted to individual plots. These individual plants were then transplanted to the field and spaced three feet apart. After harvest, the percentage of seed produced by approximately ten thousand such spaced plants was determined. These data are summarized in the following table:

TABLE 4. — Percent Seed Produced and Percentage of Population of Dallis Grass

Percent seed class	Percentage of population in each class
10-19	0.40
20-29	3.67
30-39	11.34
40-49	38.29
50-59	34.83
60-69	10.73
70-79	0.68
80-89	0.07

From this table it may be seen that over 73 percent of the population were in the classes producing from 40 to 59 percent of good seed. Due to the wide variations found, it is believed that a continued practice of selecting the better producing plant and increasing the seed therefrom, shows promise of improving the amount of good seed produced. From these data may be seen also that Dallis grass does not produce as few seed as has been formerly assumed. Thorough cleaning of domestic seed will greatly improve the results obtained from sowing such seed.

Dallis grass also has the disadvantage of being susceptible to a disease known as ergot. When eaten in large amounts the ergot-diseased heads are harmful to cattle. Injury to livestock from this source is rare, however, and mowing or heavy grazing will prevent it.

Much work is being done in breeding and selection at the Mississippi Station, seeking an improved strain or variety of Dallis. Early results are promising in some instances, discouraging in others.

Hybrids between Dallis and resistant or immune species of paspalum are showing promise of incorporating disease resistance into Dallis.

Hybrids between Dallis and Malacophyllum (an introduced species which produces seed profusely and is immune to ergot but has undesirable growth habits) produced large quantities of seed, but germination was nearly nil.

First generation hybrids between Dallis and the various species of paspalum produced seed of a widely varying germination.

Some seven thousand second-generation hybrid plants are being grown by the Agronomy Department, from which selections are being made for plant type and seed production. This work will be reported as progress is made.

First generation hybrids beween Vasey and Malacophyllum (seed of both species germinating well above 90%) have produced seed of an extremely low germination (0.5%).

In seeding new pastures, Dallis grass should be seeded first. Where clover and grass are seeded together, the clover gets started growing first, and crowds out the young grass plants in the spring. For a mixed stand, it seems a good practice to seed Dallis in the fall, followed by lespedeza in early February, and by White Dutch or other clover the next fall.

Basic Summer Pasture Grass

Growing over a long season and on a wide variety of soils, being drought and heat resistant, and having an outstanding ability to combine with other plants—especially the legumes used in pasture mixtures—has caused Dallis grass to be recommended as the basic summer grass for permanent pastures. It should be included in all pasture mixtures except those planted on extremely sandy soils.

Bermuda Grass

Cynodon datylon

Bermuda is a low, sod-forming, perennial grass. It is commonly propagated by means of both surface run-

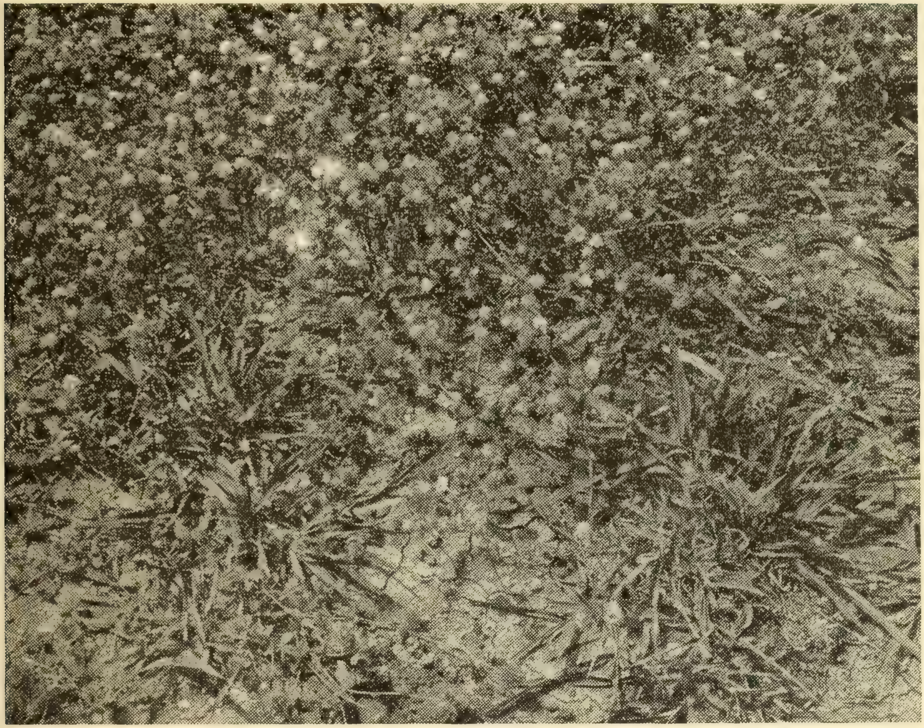


FIGURE 4.—Showing how clovers crowd young grass plants when sown together in the fall. The better practice is to establish the grass stand, then the clover stand.

ners and underground rootstocks. These growth characteristcis make it our best soil conserving crop and at the same time a serious pest where not wanted. It is at present the most widely used permanent pasture grass in the state.

Bermuda grass is adapted to practically all soils in the state that are fairly well drained and not extremely poor. Bermuda, like Dallis, is able to make creditable growth only on soils of at least a fair level of fertility.

Bermuda grass makes excellent pasturage when young and succulent. With the coming of summer or droughty conditions it soon becomes fibrous and unpalatable.

Establishing Bermuda Grass

Bermuda is propagated principally by means of sod parts. The recommended method is to place pieces of sod at three to four foot intervals, or to scatter sod parts and cut in with a disc. This method is costly, requires a long time for establishment, and success is dependent upon moisture conditions.

Good stands of Bermuda grass are difficult to obtain by means of seed. Seedings must be relatively heavy, 10 to 20 pounds per acre, and on a prepared seed-bed. Experimental evidence has shown that Bermuda seed should be planted deeper than formerly thought sufficient. Better results have been obtained by seeding one-fourth inch deep than by surface seeding, with or without harrowing.

Whether seeded or sodded, Bermuda must be given time to establish itself.

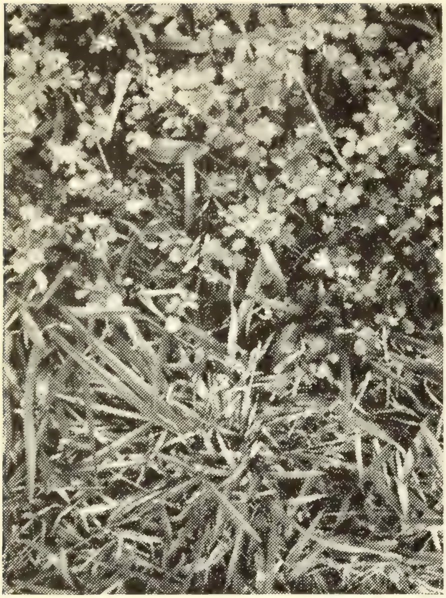


FIGURE 5.—Looking directly down on a Carpet grass sod, showing how completely it is crowding out Hop clover. Note the density of the sod formed by this grass. Photograph taken at the Natchez Branch Station.

Grazing soon after germinating or sprig sodding will weaken the plants and prevent formation of enough rootstocks for complete ground coverage. Recently sodded areas should be grazed lightly, if at all, to permit complete coverage of the ground. One to two years are necessary for the establishment of a full sod.

Were it not for expensive establishment, lack of drought resistance, becoming fibrous soon in the season, and were it not a pest where fields are to be rotated, Bermuda would be our best summer pasture grass.

Carpet Grass

Axonopus compressus

Carpet grass is also a low, sod-forming, perennial grass. It is propagated by seed and by creeping plant parts. Being adapted to moist bottomlands, Carpet grass forms a dense sod which is difficult to eradicate. Too, the density of the sod makes it extremely difficult for other pasture plants to grow in combination with Carpet grass.

Pastures in areas where conditions are favorable for the growth of Carpet grass, as in South Mississippi, usually have only this grass for grazing. Such pastures can be and should be improved by disking, liming, phosphating, and seeding Dallis grass and clovers.

Establishing Carpet Grass

Seedings of Carpet grass, like Bermuda and Dallis, must be given time for establishment. Seedings at the Natchez Branch Station have shown that it takes two years for establishment by means of seed, even when sown on a prepared seed-bed at the rate of 15 pounds per acre. So prevalent is this grass in regions of South Mississippi, however, that clearing the land of trees and brush results in complete ground coverage the second year without seeding.

Because of its low nutritive value and its habit of growth which crowds out the much more desirable pasture plants, pasture seedings of Carpet grass are not recommended.

White Dutch Clover

Trifolium repens

White Dutch clover is the best spring pasture clover for the majority of Mississippi pastures. It is a shallow rooted, perennial plant that creeps on the surface and takes root at the joints. This clover gives grazing over a longer period than any other of our spring clovers because of its indeterminate habit of growth—growing, blossoming, and seeding at the same time. It seeds profusely throughout its growing season, and with the coming of dry weather will lie dormant until moisture conditions are favorable when it again begins growth, blossoming, and seeding.

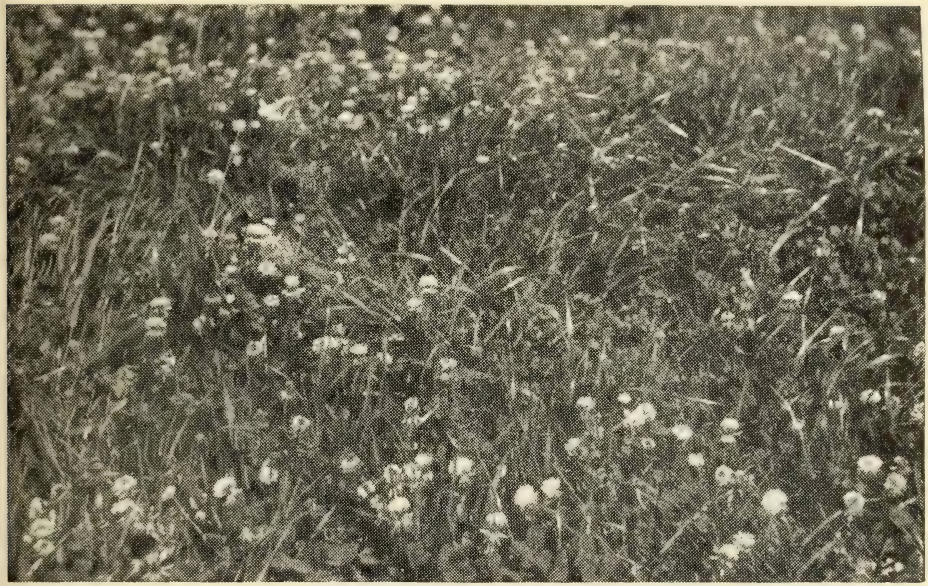


FIGURE 6.—White Dutch clover and Dallis grass growing on Waverly soil, a relatively poor cotton producing soil of the Delta.

The other pasture clovers, being determinate in their habit of growth, finish their growth when they have seeded. This plant habit often causes White Dutch to yield more plant material per acre than many other more upright growing clovers.

White Dutch clover is adapted to all soils of the state where moisture is sufficient for its growth, its first requirement being a soil well supplied with moisture. This is why it will be found more frequently in the bottomlands of the hill section of the state and will do better on the heavier Delta soils under average conditions. Like other crops, White Dutch does best on fertile soils but will grow well on any soil that will produce the common pasture grasses. Much of our Delta soil, because of its high silt content, poor drainage, and consequent high moisture content will grow clover and grass to advantage.

Comparative Yield of Clovers

Where moisture and fertility are not limited, White Dutch clover will yield hay in quantities comparable with our commonly used clovers. In an experiment conducted on Memphis silt loam at the Natchez Branch Station, all clover seeded in October at the rate of eight pounds per acre and harvested when in full bloom produced in the spring of 1941 the following amounts of green weight per acre:

TABLE 7.—Yield of Green Weight Per Acre, Six Clover Varieties.

Variety	Pounds green wt. per acre
Persian	12110.1
White Dutch	22216.4
Low Hop	15043.2
Red	18615.3
Crimson	24400.3
Lappa	16036.4

From these data it may be seen that White Dutch clover was outyielded by only one variety, Crimson. Yields would vary much more if harvest had been made under conditions similar to those of pasturing, rather than as for hay. The continuous biting or cutting off of the leaves causes White Dutch to stool more freely than the other varieties; this is a very important pasture plant characteristic, resulting in larger total yields when measured throughout the grazing season.

Establishing White Dutch Clover

White Dutch clover should be sown after the grasses have been established. This prevents shading young grass plants, and the existing grass cover serves as a protection to the clover seedlings. When sown on established grass sod, three to five pounds of seed are sufficient to give a good stand. This should be sown in the fall, by November 1. After seeding, it is well to run a spike-toothed harrow over the sod which shakes seed to the ground and the harrow tracks serve as lodging places for the small seed in case of excessive rainfall.

When seeding alone, six to ten pounds per acre are needed, as shown by table 5.

TABLE 5.—Rates of Seeding as Affecting Yield of Green Weight of White Dutch Clover When Sown Alone

Rate of seeding pounds per acre	Yield green wt. per acre—1939
2	5260.8
4	6250.8
6	9430.8
8	10367.3
10	11587.0

Fertilizing White Dutch Clover

White Dutch clover responds to lime and phosphate fertilization on soils low in these elements. Grown on Grenada silt loam with and without lime, the White Dutch clover yield, without lime, was doubled by 100 pounds of 16% superphosphate and trebled by 200 pounds. (See table 6). With a small amount of lime, however, the 100-pound phosphatic treatment produced three times and the 200-pound phosphatic treatment produced six times the amount of green weight per acre. It will also be noted that lime without phosphate reduced the yield, and that White Dutch clover does not require as high a rate of phosphatic fertilization on Grenada silt loam soil as thought previously.

Another plant characteristic that causes White Dutch to be so valuable a pasture plant is its high percentage of leaves, even when maturing seed. This gives better grazing than the more upright, stemmy clovers.

More Protein In White Dutch

That the high percentage of leaves means higher feeding value may be shown by the protein and phosphorous content of several of the clovers used for pasture grown on eroded Houston soil of the "Prairie'' belt. Chemical analyses of seven clover varieties show, in table 8, that White Dutch contains about one-fifth more crude protein than any other clover tested and about fifty percent more protein than four of the six clovers tested.

TABLE 6.—EFFECT OF LIME AND PHOSPHATE ON WHITE DUTCH CLOVER — HOLLY SPRINGS — 1941

Pounds 16% superphosphate per acre	Green weight per acre with 1000 lb. Dolomite	No lime
None	3472.7	4094.6
100	10149.5	8899.3
200	19196.5	12131.5
300	15173.8	14331.2

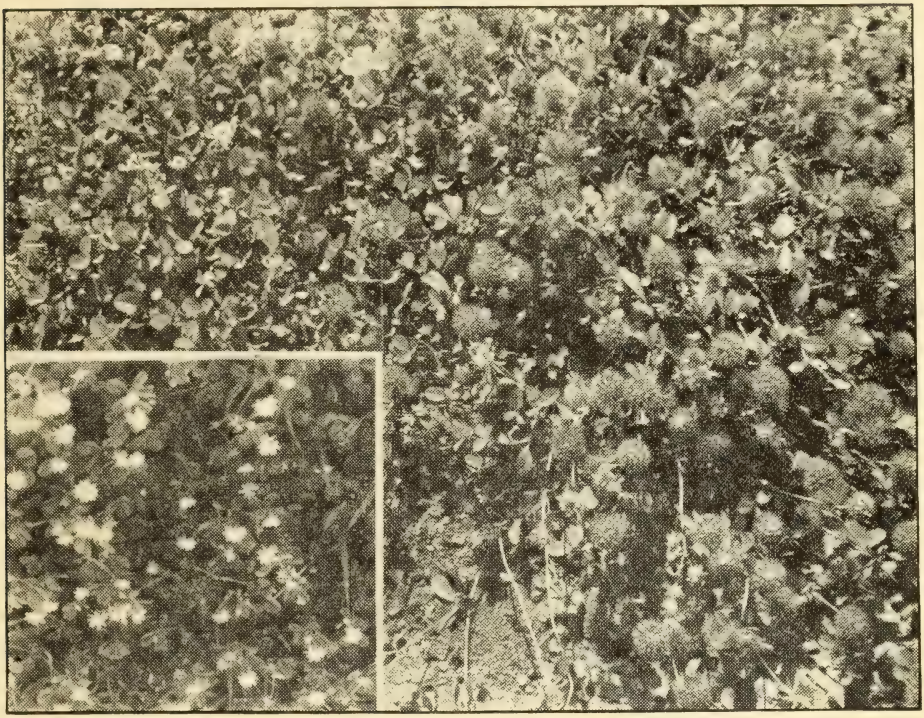


FIGURE 7.—a. White Dutch clover on top left, Persian on the lower left. Note leafy nature of White Dutch and the stemmy, open nature of Persian. b. White Dutch clover on top left, Lappa clover on right. Note the large proportion of stems in Lappa, even when just past flowering.

TABLE 8.—Chemical Analysis of Various Clover Varieties at Flowering

Clover variety	Percent crude protein	Percent phosphorous
White Dutch	23.29	.33
Persian	19.17	.24
White Sweet	15.51	.15
Black Medic	16.54	.20
Crimson	15.69	.19
Red	15.43	.24
Low Hop	14.64	.16

Basic Spring Clover For Pastures

Because of its wide soil adaptation, its profuse seeding and stooling habits under grazing conditions, its yielding ability under conditions of sufficient moisture, and its high food value for grazing, White Dutch clover is recommended as the basic spring clover for Mississippi pastures.

Hop Clover

Trifolium dubium, T. procumbens

The Hop clovers are winter annual clovers with small stems which branch from the base upward. The general type of growth is similar to that of the lespedezas.

Two species of Hop clover are found in Mississippi pastures, Least Hop (Trifolium dubium), by far the predominating, and Low Hop (Trifolium procumbens). Low Hop grows larger and has a much larger seed head than Least. The two look very much alike until they bloom. Low Hop has yielded almost twice as much plant material per acre

TABLE 9.—EFFECT OF PHOSPHATING ON THE YIELD OF LOW HOP CLOVER.

Treatment	Green weight per acre	Dry weight per acre
None	3726.8	1016.3
200 ℔ 20% Super	9583.2	2371.8
400 ℔ 20% Super	13213.2	3049.6
800 ℔ 20% Super	13745.6	3019.9

at the West Point field as has Least Hop.

The Hop clovers are adapted to most of the soils of the state. Although they will grow on soil of a lower level of fertility than White Dutch clover, the use of phosphate will greatly increase their yield. This may be shown by results obtained from rates of phosphate application on Low Hop clover at the West Point field.

Fertilizing Hop Clovers

A pure stand of Low Hop growing on eroded Houston soil was treated in the fall of 1938 with broadcast applications of varying amounts of 20% superphosphate. Plots were harvested when in full bloom, and green weight and dry weight yields per acre are shown in table 9.

From this table it may be seen that 200 pounds of superphosphate per acre increased the dry weight yield of clover 1355.5 pounds or 133.4 percent. An additional 200 pounds of superphosphate further increased the yield 677.8 pounds or a total increase over no treatment of 2033.9 pounds. This increase is almost exactly three times the amount produced on the untreated areas. Increasing the amount of superphosphate applied above 400 pounds per acre gave unprofitable increases.

The Hop clovers will survive heavy grazing and will reseed themselves under the most adverse conditions. This, coupled with the ability to grow on the poorer soils, makes the Hop clovers more dependable than the other spring clovers under severe pasture conditions. However, this advantage over White Dutch clover is overcome by light phosphate applications to pastures containing or to be planted to White Dutch clover.

Establishing Hop Clovers

Planting dates and methods of seeding the Hop clovers are the same as those for White Dutch. Clovers sown on land that has not previously grown clover should be inoculated.

Where conditions of moisture and fertility are not favorable to the growth of White Dutch clover, or where no fertilization is to be practiced under these conditions, the Hop clovers will prove to be the more dependable spring clover. However, under any system of improvement or on land of average fertility, White Dutch clover will prove to be more productive than Hop clovers.

The Lespedeza Species

L. Striata, L. Stipulacea

The annual species of lespedeza are the only summer legumes that are able to persist and furnish grazing in permanent pastures in Mississippi.

Common (Lespedeza striata) is the best of the annual species for pasture. This superiority is due to its higher per acre yield and to the fact that it is the only species that will reseed itself consistently under grazing conditions. In spite of the high cost of seed at present, this species is preferred because of its reseeding ability. However, the cost of seed will make it more economi-

TABLE 11.—COMPARATIVE YIELDS OF THE ANNUAL VARIETIES OF LESPEDEZA.

	Pounds dry weight per acre on soil types:				
Variety	Lufkin[1]	Ruston[1]	Grenada[1]	Olivier[2]	Memphis[2]
Common	1810.7	1304.3	3311.1	3354.1	2890.6
Kobe	3358.3	2038.3	2640.8	3238.0	5916.2
Tenn. 76	3236.6	2224.8	4058.1	3165.4	———
Korean	2397.1	1586.2	1588.9	2758.8	3276.1

[1] 3-year averages. [2] 2-year averages.

cal to sow a lespedeza mixture containing only a small amount of Common lespedeza and a large amount of some other species. After two or three years of grazing, Common will be the only species remaining. In pastures or meadows, the necessity of reseeding other annual varieties every two or three years will in only two seedings balance the difference in seed cost between the less costly lespedeza and Common. The Tennessee 76 variety of Common behaves in the same manner as does Common and differences are difficult to distinguish.

Wide Adaptation to Soils

The annual lespedezas are adapted to almost all the soil types of the state having a fair degree of fertility. Although lespedeza will respond to liming, Korean (Lespedeza stipulacea) is the only variety that is dependable on the black soils of the "Lime" or "Prairie" belt, and only on this soil is Korean recommended over the other annual varieties. With the exception of this type of soil, the annual varieties show little preference for soil types of the state.

The lespedezas are very palatable and nutritious and for this reason should be included in the pasture mixture. This may be seen by the protein content of the different varieties harvested at flowering, grown on three widely varying soil types.

TABLE.—Crude Protein Content of Annual Lespedezas

	Percent protein on three soil types:		
Variety	Lufkin	Ruston	Grenada
Common	17.12	15.43	16.85
Kobe	16.50	16.31	16.15
Tenn. 76	15.39	15.75	16.05
Korean	15.25	16.30	15.35

High Yields of Herbage

Coupled with a high food value is the amount of herbage produced per acre. Tests comparing the hay yields of miscellaneous types of forage crops have shown that the annual lespedezas will outyield the taller growing crops as cowpeas, soybeans, millets, and hay sorghums under average Hill section conditions. They are by far the best hay yielders where the crop is sown broadcast. The comparative yielding ability of the annual varieties without fertilization on several soil types is shown in table 11.

From these data it may be seen that Kobe and Tennessee 76 (both Lespedeza striata) are generally the higher hay yielders. On the Grenada and Olivier soil types the Common variety outyielded the other varieties. On soils with sufficient moisture Common lespedeza will be as productive as the other annual varieties.

Establishing Lespedeza

The annual varieties of lespedza should be planted as soon after the first of February as possible, and certainly before March 15. By early sowing, the lespedeza plants are able to make sufficient root growth to carry them through the dry periods in the spring which are so often fatal to plantings made after March 15. Losses of early plants due to cold are more than offset by the early establishment of surviving plants. Regardless of whether sown on bottom or upland soils or for what use, lespedeza should be sown early in Mississippi.

Considerable difficulty has been experienced in many sections of the state in holding lespedeza stands where fertility and moisture conditions are favorable for good growth of spring clovers, because the earlier growth of clover shades out the young lespedeza plants. Tests have shown that such growth kept five inches or less in height, whether by mowing or grazing, will insure lespedeza growth during the summer. Such a condition may be made advantageous in several ways. Early mowing will eradicate several species of spring weeds, and clippings can be stacked for supplemental feeding during dry periods in the summer or for winter feeding of livestock.

The annual varieties of lespedeza may be sown on sod without any soil preparation. It is advisable to run a spike-tooth harrow over the sod after seeding. This serves as needed preparation and provides a lodging place for seed in case of excessive rains.

If use is to be made of the lespedeza crop the first year, relatively heavy seeding should be made. Sowing 25 pounds per acre will result in a hay crop or good grazing the year seeded. If a volunteer crop is desired or the pasture is to be lightly grazed, 10 to 15 pounds of seed will be sufficient to produce a good stand the second year.

Lespedeza, Basic Summer Legume

Being adapted to almost all the various soil types of the state, very palatable and nutritious, able to persist and reseed under grazing conditions—makes Common lespedeza the basic summer legume recommended for permanent pastures in Mississippi.

Black Medic

Medicago lupulina

Black Medic is a low, spreading winter annual legume belonging to the same family of plants as alfalfa and Bur clovers. It is superior to the Bur clovers as a pasture plant because of its reseeding ability under grazing conditions, because it affords grazing later in the season, and because it is more palatable to livestock.

This clover is more specific in its soil adaptation than the other commonly used pasture clovers. It makes its best growth on soils of high lime content and those containing a considerable amount of clay. For this reason Black Medic makes a good pasture supplement on soils of the "Prairie" belt.

Black Medic is erratic in its production. That is, in some years it will yield abundantly while in others there will be hardly any present. For this reason Black Medic is considered as a pasture supplement for those soils high in lime or containing considerable clay, and is not placed in the statewide pasture mixtures.

Persian Clover

Trifolium respinatum

Persian clover is a rather stemmy winter annual clover. In thick stands Persian clover will often obtain a height of two feet or more. In such instances there will be a mat of stems near the ground and a cover of leaves near the top, much the same as with the Bur clovers. Unless kept closely grazed or mowed Persian clover will smother and shade the summer plants to such an extent that grazing of these later plants is delayed as much as three weeks after Persian clover has matured. This habit of growth—long stems and seeding near the top—makes it less persistent under grazing than White Dutch and, therefore, not as dependable a pasture plant.

Since its soil adaptations are much the same as those for White Dutch, Persian is especially adapted to moist, fertile bottomlands. It may be used to advantage on low or semi-moist soils to utilize such areas as temporary pastures. Especially is this true in the Prairie and Delta sections. Seeding dates and rates are the same as those for White Dutch.

Being adapted to the same soil types and conditions, the fact that it is more stemmy and less persistent under grazing conditions makes Persian a less desirable pasture plant than White Dutch clover and it is at present classed as a supplement or temporary pasture plant.

Lappa Clover

Trifolium lappaceum

Lappa clover is a winter annual with a semi-erect habit of growth. There is a high percentage of stems in relation to leaves, and after flowering the seed heads make up nearly one-half of the total plant weight.

This clover is adapted to the same high-lime type of soil as Black Medic. Its yielding ability is less than White Dutch on soils adapted to White Dutch. Its place appears to be on the soils of the Prairie region.

Alyce Clover

Alyscarpus vaginalis

Interest has been manifested in this plant to such an extent that it seems desirable that preliminary work done on Alyce clover crop be reported.

Although Alyce clover is a legume, it is not a true clover as its trade or common name would imply. It is an upright annual plant and makes a quick summer growth. The upright single stem type of growth makes questionable its value as a permanent grazing crop.

Hay yield tests conducted in 1940 show this crop to produce along with the lespedezas. At Natchez Alyce clover outyielded the highest yielding annual lespedeza, Kobe, by 1489 pounds per acre. At Holly Springs this same lespedeza variety in 1940 yielded within 200 pounds of Alyce clover.

At Natchez the yield of Alyce clover was 7405 pounds or 3¾ tons of hay per acre, while Kobe lespedeza yielded 3 tons per acre. At Holly Springs Alyce clover yielded 3947 pounds, and Kobe produced 3738 pounds of hay per acre.

No seed were produced at Holly Springs, and only a few at Natchez. After only one year's experience it is not known whether Alyce clover will reseed itself under Mississippi conditions.

One important characteristic of Alyce clover from the hay production standpoint is its relatively high percentage of dry matter. Of the amount of growth produced above ground, 42 percent was dry matter. Another desirable hay characteristic of this plant is its percentage of leaves. Approximately 46.5 percent of the growth harvested is leaves and 53.5 percent is stems. Here the annual lespedezas step ahead, even of the high leaf percentage of Alyce, as the ratio of leaves to stems is reversed. The lespedezas are also superior in protein content. The Alyce clover material produced last season (1940) contained 11.26 percent protein, while the lespedezas contained from 14 to 18 percent protein at flowering. These characteristics show its resemblance to lespedeza as a hay plant and indicate it may be handled in the same manner as lespedza for hay, and should be used only as a temporary or supplemental pasture plant.

This plant is not frost resistant and should be sown after May 1. It may be sown broadcast or drilled and at the rate of 15 to 20 pounds per acre.

One year's results obtained on thin Grenada soil shows that this crop responds to fertilization.

TABLE 12.—Alyce Clover Fertilization

Fertilization	Pounds dry weight per acre
None	3947.0
200 ℔ 20% Superphosphate	4351.8
200 ℔ Super + 50 ℔ Muriate Potash	5566.2

Since Alyce clover is a new crop plant to Mississippi, farmers are advised to treat it as an experimental crop until its value and place can be determined.

SEEDING AND MOWING FOR IMPROVEMENT OF PASTURES

Observations will reveal that almost all of the native or existing Mississippi pastures are yielding far less than their maximum production or carrying capacity. The reasons for this are principally, (1) the lack of fertility, and (2) the presence of plants that are productive or palatable only for short periods of the grazing season. Improvement of these pastures by the alteration of these conditions would enable a greater carrying capacity and a consequently increased efficiency, and thereby increase milk and meat production.

The rate at which Mississippi pastures may be improved is directly dependent upon the rate of the application of the practices of seeding, mowing, and fertilization. When these factors are satisfied, the maximum production of the pastures then becomes dependent upon management.

Seed Superior Pasture Plants

Plants recommended for seeding in pastures have been discussed. The superiority of the plants recommended lies in the fact that they are much higher in food value, remain palatable to livestock over a longer period, and withstand grazing and adverse weather conditions better than other plants now found in pastures.

Mowing to Control Weeds

Timely mowing is one of the most important pasture improvement or management practices that Mississippi farmers can follow.

This is especially true on soils of a medium or low fertility, even when seedings of desirable plants have been made and satisfactory stands obtained. The desirable plants are in competition with the undesirable plants for soil moisture and plant food. The undesirable plants, as the weeds and sedges common to Mississippi, are able to grow on soils of a lower level of fertility than are the grasses and legumes used for pasture. Usually taller in growth, they tend to shade out the desirable low-growing plants. They are unpalatable to livestock and are thus allowed by grazing animals to grow and produce seed unhindered, while the desirable plants are grazed and their seed production is greatly reduced.

Seed Produced by Common Weeds

The number of seed produced by the common weeds is surprisingly large. Averages of seed counts made on several species of weeds common to Mississippi pastures are shown in table 13. When it is realized that a single Bitterweed plant may produce 3102 seed, and a single Daisy Fleabane plant produces 22785 seed—it is easy to understand why weeds unhindered "take" a pasture.

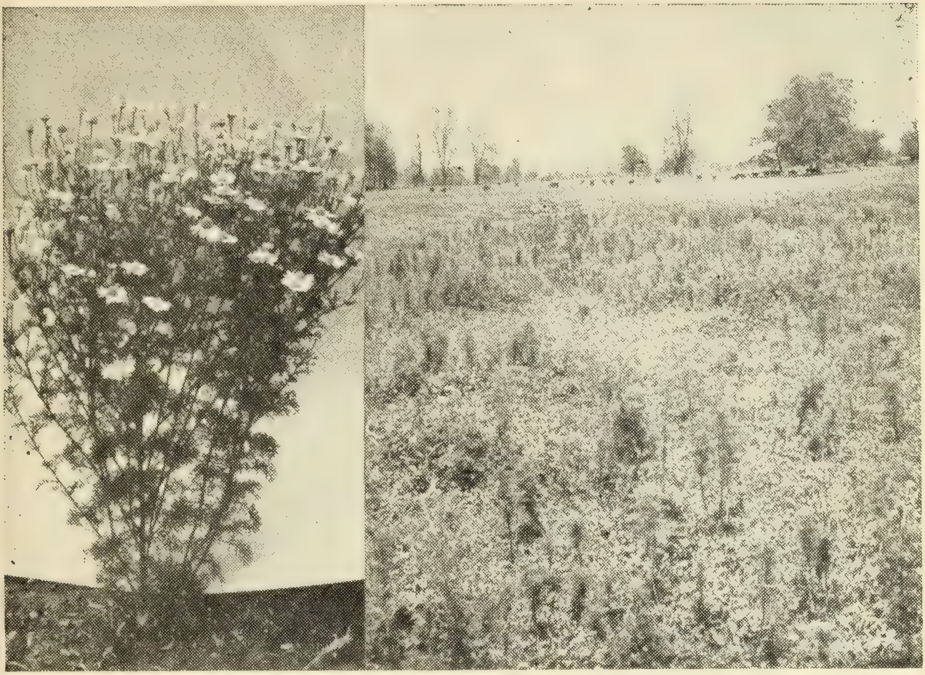


FIGURE 8.—Left. A single Mayweed plant. Right: Mayweed spreading over a good bottom pasture. Note how the clover is grazed while the weeds are going to 'seed', averaging over 2000 seed per plant.

With uneven grazing or the lack of mowing permitting weeds to make these average numbers of seed per plant, pasture plants will gradually give way to the weeds. Figures 8, 9, 10, 11, and 12 show individual weed plants and what they have done to pastures.

TABLE 13.—Seed Production of Some Pasture Weeds

Plant	Heads per plant	Seed per head	Seed per plant
Bitterweed (Helenium tenufolium)	24	130	3120
Mayweed (Anthemis cotula)	12	169	2028
Thistle (Circium lanceolatum)	12	863	10356
Daisy Fleabane (Erigeron philadelphicus)	93	245	22785
Curled-leaf Dock (Rumex crispus)	—	—	10506

The value of mowing for the control of weeds is emphasized by data obtained in a mowing test conducted at the Central Station.

Used in this test was an established permanent pasture on Houston soil. Grazing was made up principally of Dallis and Bermuda grasses, and Hop and White Dutch clovers. Portions of the pasture were left unmowed for comparison with the mowed area. No other treatment was employed.

Palatability Improved by Mowing

Representative areas of both mowed and unmowed areas were protected from grazing by means of movable cages, and total yields were obtained by harvesting the growth at frequent intervals so as to duplicate as far as possible the conditions of grazing. Unprotected areas of the same size, mowed

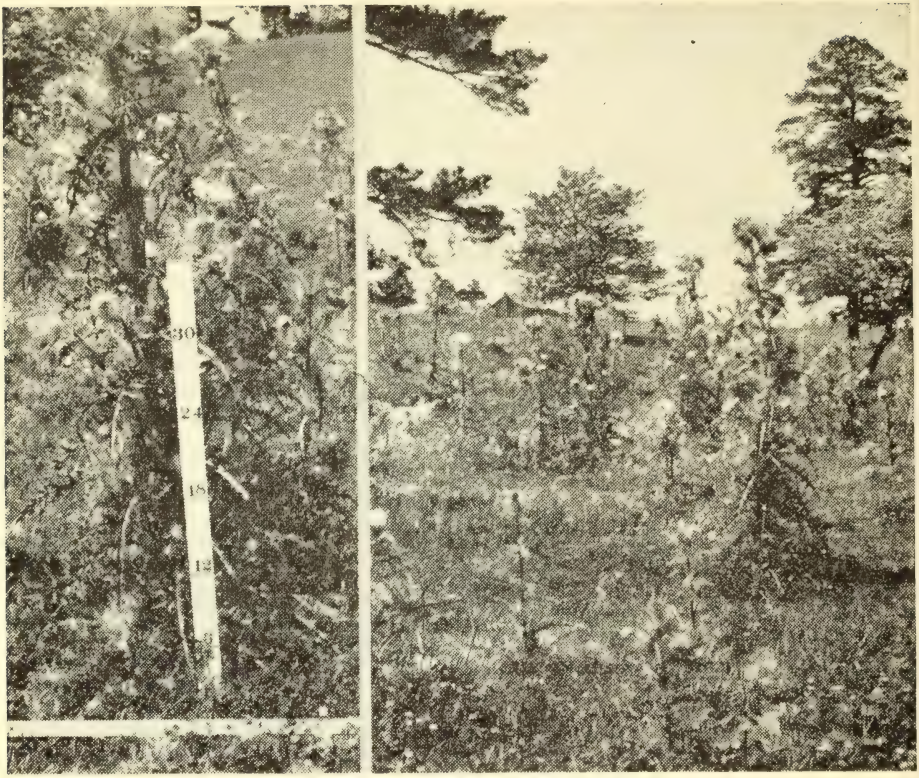


FIGURE 9.—Left: A single Bull Thistle plant maturing seed. Right: Thistle covering a southwest Mississippi pasture, each plant maturing on an average of 10,356 seed.

and unmowed, and representative of the growth left by grazing cattle, were harvested at the same time. The difference between the yields of the protected and the unprotected areas represents the quantity of pasture growth that was eaten by grazing cattle. The three-year average yields are reported as dry matter per acre in table 14.

Several very significant and important results are shown in this table. Most significant is the fact that the cattle left two and one-half times the amount of herbage produced on the unmowed plots as was left on the mowed plots. This was due to the presence of weeds and unpalatable plants on the unmowed areas. The tall undesirable plants—Daisy Fleabane and Mayweed during the spring, and ragweed during the summer—growing in combination with the clovers and grasses, caused the unmowed areas to yield slightly more plant material per acre. The average

TABLE 14.—EFFECT OF MOWING ON THE YIELD AND COMPOSITION OF PASTURE MATERIAL

Treatment	Dry wt. yield	Seasonal averages	
		Percent not eaten	Percent protein
Mowed	4052.6	20.28	11.76
Unmowed	4386.6	50.18	6.92

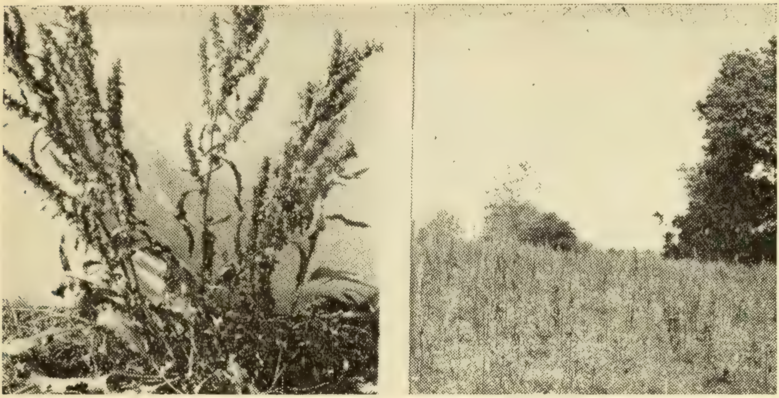


FIGURE 10.—Left. A curled Leaf Dock Plant. Right: Each plant averaging 10,505 seed results in such a stand of Curled-leaf Dock on a Mississippi pasture.

difference in yield was 334 pounds of dry material or 8.2 percent in favor of the unmowed plots.

The yields of plant material do not tell the full story of pasture production, however. The one purpose of pasture forage production is that it be eaten by livestock. In this test, the cattle grazed 79.7 percent or 3230 pounds of forage produced per acre on the mowed area; and the cattle grazed only 49.8 percent or 2195 pounds of forage produced on the unmowed area. Thus, although slightly more forage was produced on the unmowed area, the grazing animals secured actually about 50 percent more feed from the mowed area.

Protein Increased by Mowing

Quality of production must also be considered. The lower crude protein content of the herbage produced on the unmowed areas over-balanced the slightly greater yield of plant material per acre. Producing an average of 4386.6 pounds of dry material per acre of a 6.92 percent crude protein content means an acre production of 304.4 pounds of crude protein from the unmowed area. The mowed area had a seasonal average of 11.76 percent protein, which equals 476.6 pounds of crude

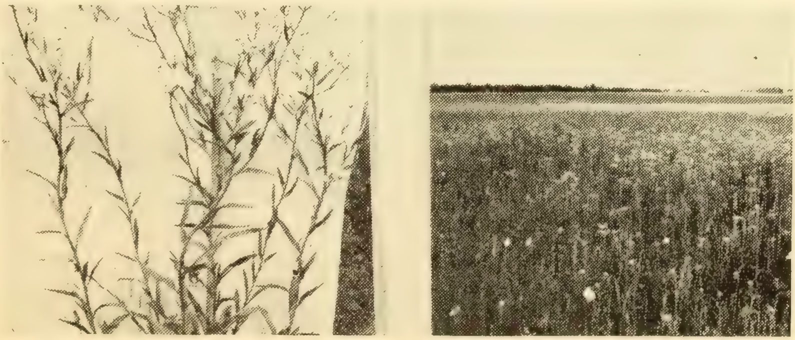


FIGURE 11.—Left: A Daisy Fleabane plant. Right: Unhindered production of an average of 22,785 seed per plant resulted in such a population of Daisy Fleabane plant on this "Prairie" belt pasture.

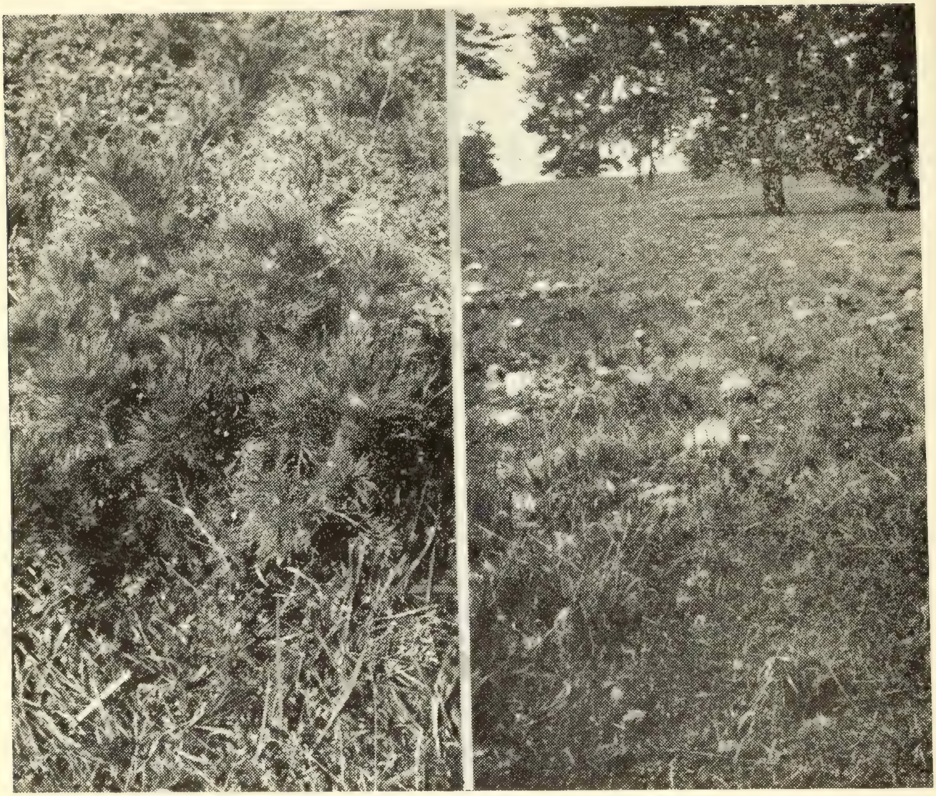


FIGURE 12.—Right: This southwest Mississippi pasture was mowed—but too late. Notice how thoroughly the Bull Thistle heads the bunches of feathery seed have been spread over the area which will serve as reseeding. Left: Dog Fennal (Eupatorium perfoliatum) beginning its second year's growth. Plants are arising from the under-ground portions which have served for storage over the winter.

protein per acre. This is a difference of 172 pounds of crude protein in favor of mowing, and the difference is equivalent to the amount contained in 422 pounds of 41 percent cottonseed meal. Timely mowing prevents the production of weed seed. By eliminating the uneven competition due to selective grazing and by consequent reduction of the weed population, improves the quality of pasture production.

Timely mowing is not just mowing, and weeds cannot be controlled by mowing after they have seeded. Mowing after seed have matured serves as reseeding rather than as control, as shown by the accompanying photograph (Figure 12).

Time of Mowing Important

Bitterweed and Mayweed should be mowed when blossoms have started forming rather than after they begin to bloom, for at this stage the seed are capable of germinating. Other annual weeds should be mowed when flowering begins. It is necessary to mow perennial weeds for two or three years, as they produce under-ground plant parts, by means of which they live from year to year. If these storage parts are not dug, the above-ground portion must be kept mowed until all storage material in the under-ground parts is used in initiating new growth (figure 12, left).

Other than improving the quality of production by weed control, mowing improves the quality of desirable pasture plants. The crude protein content of Dallis or Bermuda grass can be increased by mowing, so that the seed stalks and fibrous growth are soon replaced by leaf growth.

The harvested material from a pure stand of Dallis grass when in the seeding stage analyzed 6.9 percent crude protein. Two weeks later the material harvested from the same area contained 18.74 percent. A pure stand of Bermuda grass handled in the same manner produced, in the seeding stage, material containing 7.1 percent crude protein while material harvested two weeks later was of a 19.08 percent crude protein content. In both these instances the protein content of desirable pasture grasses was more than doubled by mowing.

IMPROVEMENT PRACTICE MOST NEEDED IS FERTILIZATION

Probably the most needed pasture improvement practice on the majority of existing Mississippi pastures and areas to be put to pastures is that of proper fertilization. This is due to the custom of placing pastures on areas too low in fertility for economical production or on land that has been cropped or eroded until it has become unproductive, and to grazing pastures over a long period without returning plant food elements so removed.

Information on the fertilization of pastures in Mississippi is extremely limited and much more research work is needed. However, preliminary tests have shown such promising results from the top-dressing of existing pastures and the fertilizing of newly seeded pastures that it is deemed advisable to report them at this time.

Used in a test at the Holly Springs Branch Station was an established permanent pasture that would be considered an average of the pastures in the hill sections of this area. A series of fertilizer treatments was applied broadcast in February on random plots throughout the pasture. One application of lime was made during the period, all other treatments being annual applications. Check plots were left untreated for comparison.

Areas of both fertilized and check plots were protected from grazing by means of movable cages. Total yields were obtained by harvesting the growth at frequent intervals so as to simulate grazing conditions. Unprotected areas of the same size and number, treated and untreated, and representative of the growth left by grazing cattle, were clipped at the same time. All yields are reported as dry matter per acre. The difference between the yields of the protected areas and yields of the unprotected areas represents the quantity of pasture growth that was eaten by the grazing dairy animals. These differences are herein reported as the percentage of growth not eaten. Four year averages of yields and rate of grazing are reported in table 15.

These four-year averages show several outstanding and significant results. Surprising may be the effect of liming, in that 4000 pounds of dolomitic limestone applied in 1937 caused these plots to yield less than the untreated plots four seasons later or in 1940. However, there was only 276.3 pounds of dry matter per acre difference in favor of the unlimed plots in 1940. How long this overliming effect will remain will be ascertained by further measurements. These results indicate the ad-

TABLE 15.—INFLUENCE OF FERTILIZATION ON THE YIELD AND GRAZING OF TOPDRESSED PASTURES ON GRENADA SOIL.

Fertilizer Treatment	Pounds dry matter per acre av. 1937-40	Percent of growth not grazed
L - Lime 4000 lbs. (applied 1937)	2904.0	32.16
P - 400 lbs. Superphosphate (20%)	6193.6	6.44
N - 250 lbs. Nitrate of Soda (16%)	3891.3	40.12
K -80 lbs. Muriate of Potash (50%)	3742.8	22.43
LP*	5237.0	5.64
LK*	4006.0	18.27
LN*	4858.7	30.09
LPK*	4561.5	15.80
LPKN*	5542.6	25.13
None	3236.3	23.91

*Combination of lime, phosphorous, nitrogen, and potash in quantities listed in first four lines of table.

visability of smaller amounts of limestone, applied more frequently, when broadcast on pastures growing on this type (Grenada silt loam) of soil.

Fertilizer Highly Effective

Outstanding are the results obtained by the application of phosphate. The use of 400 pounds of 20 percent superphosphate, gave a four-year average increase over the untreated plots of 91.38 percent. This is almost a doubled yield. This increase was due to a stimulated growth of the legumes, Low Hop, White Dutch, and Common Lespedeza, as shown by accompanying photographs, figures 13, 14, 15 and 16. The use of the heavy amount of lime in combination with phosphate reduced the yield to less than the yield from phosphate alone. Heavier applications of phosphate in combination with 4000 pounds of lime failed to overcome the overliming effects.

In another experiment, not shown in the table, when 800 pounds of superphosphate were applied in combination with 4000 pounds of dolomite the four-year average was 5421.9 pounds of dry matter per acre. This is a difference of only 184.9 pounds of dry matter per acre in favor of the doubled phosphate application. The likelihood is that the large amount of lime not only ties up the phosphate in unavailable form, but also ties up other elements, and that in such combination they are unavailable and are thus the limiting factors for plant growth.

Further observation of the data (table 15) shows that the application of other elements alone or in combination with lime failed to give increases like those obtained with phosphate alone.

Yearly applications of phosphate gave yearly increases in plant production. One 400-pound application made in

TABLE 16.—THE EFFECT OF A SINGLE APPLICATION AND OF FOUR ANNUAL APPLICATIONS OF SUPERPHOSPHATE

Treatment	Pounds dry matter per acre			
	1937	1938	1939	1940
Check	1763.3	3912.3	3578.2	3691.2
400 lbs. Super in 1937	3097.3	6324.9	4399.8	4495.2
400 lbs. Super annually	3097.3	8787.2	5769.3	7120.5
	Percent increases over check			
400 lbs. Super in 1937	75.7	61.6	23.0	21.8
400 lbs. Super annually	75.7	124.6	61.2	92.9

1937, however, with no additional application thereafter, was giving an increase over the no-phosphate plots four years later. This comparison is shown in table 16.

These data show that one application of phosphate resulted in increased yields during three crop years and was still increasing the yield of this pasture by 21.8 percent the fourth year after application, or by 804 pounds of dry matter. Annual applications were still almost doubling (92.9% increase) the yield in the fourth year, and this increased yield amounted to 3429 pounds of dry matter that year.

Phosphated Plots Grazed Best

Very significant is the manner in which cattle grazed these plots. It will be noted that where phosphate was used there was not only more plant material produced, but also the plant material produced was grazed in preference to other treatments. This was true whether the phosphate was applied alone or in combination with other elements, though it was observed that the cattle left more of the herbage on plots treated with various elements than they did on plots with the same treatments plus phosphate.

The application of nitrogen increased the yield per acre but the growth was grazed less than the check plot. Lime with nitrogen increased the percentage grazed over the nitrogen-alone plots, but they were also grazed less than the check plots. Grass growth was stimulated by nitrogen alone and in combination, but this growth was fast and soon became fibrous and the cattle grazed the growth produced on other treated plots in preference.

The preference of cattle for the material produced on the fertilized plots is due not only to the stimulated legume growth but also to the increase in the chemical composition of the plants. Since cattle grazed the phosphate and the lime plus phosphate plots to a greater extent than others, the seasonal composition of the herbage produced on these plots in comparison to that produced on the lime and check plots was recorded and is shown in table 17.

TABLE 17.—COMPOSITION OF PASTURE CLIPPINGS AS AFFECTED BY FERTILIZATION

Treatment	Year	Calcium	Phosphorous	Crude protein
None	1937	0.67	0.15	9.50
2000 lb. Dolomite	1937	0.71	0.13	9.37
80 lb. P_2O_5*	1937	0.94	0.21	11.40
2000 lb. Dolomite and 80 lb. P_2O_5	1937	0.97	0.23	12.97
None	1938	0.67	0.16	12.32
2000 lb. Dolomite	1938	1.02	0.21	11.44
80 lb. P_2O_5	1938	1.06	0.25	14.64
2000 lb. Dolomite and 80 lb. P_2O_5	1938	1.02	0.28	15.56
None	1939	0.51	0.12	9.54
2000 lb. Dolomite	1939	0.59	0.12	9.30
80 lb. P_2O_5	1939	0.90	0.25	13.29
2000 lb. Dolomite and 80 lb. P_2O_5	1939	0.98	0.26	14.36
None	1940	0.29	0.13	6.50
2000 lb. Dolomite	1940	0.34	0.13	7.13
80 lb. P_2O_5	1940	0.50	0.21	8.17
2000 lb. Dolomite and 80 lb. P_2O_5	1940	0.46	0.22	7.57

* 80 pounds P_2O_5 from 400 pounds 20% superphosphate.

These data show that where phosphate was used there resulted an increase in the elements determined, whether the phosphate was used alone or with lime. This increase in food value coupled with the increase in legume growth resulted in more grazing of the herbage produced on the phosphated areas.

More Protein In Phosphated Forage

The value of phosphate as a pasture fertilizer is more outstanding when considered from the standpoint of crude protein produced per acre. The plots receiving no treatment produced herbage containing a four-year average of 310.3 pounds crude protein per acre. The plots receiving 400 pounds of 20 percent superphosphate per acre produced not only an increase in amount of pasture growth (table 16), but this herbage averaged 25.96 percent higher in crude protein. The increased yield, coupled with the increased crude protein content, resulted in an average crude protein production of 747 pounds per acre. This is a difference of 436.7 pounds in favor of the phosphate treatment, equivalent to the amount of crude protein contained in 1065 pounds of 41 percent cottonseed meal.

The results obtained from topdressing long established average pasture, caused tests to be conducted with varying fertilizer analyses on pastures seeded to the recommended mixtures. One year's results obtained with the different analyses applied at the rate of 400 pounds per acre on Grenada soil, with and without 1000 pounds of dolomitic limestone, are shown in table 18.

These data show that phosphorous was the most efficient and the most profitable element used in the test, whether the phosphorous was applied alone or in combination with other elements. Nitrogen used alone and nitrogen used with potash produced less than the unfertilized check, whether the plot was limed or unlimed. This was due to the early stimulation of grass at the expense of legume growth. Potash used alone resulted in a slightly higher yield on the limed plot and a slightly lower yield on the unlimed plot.

The highest yields were 6841.4 pounds of dry matter on the limed plots and 6367.6 pounds of dry matter on the unlimed plots. Both were secured with 400 pounds of 0 - 12 - 0 per acre, containing 48 pounds of P_2O_5, and equival-

TABLE 18.—EFFECT OF DIFFERENT FERTILIZER ANALYSES ON PASTURE YIELDS

Analyses* 400 lb. per acre	Pounds dry matter per acre Limed	Not limed
0-0-4	4493.2	3470.2
0-4-0	4680.1	4611.7
8-0-0	3845.0	3733.3
0-8-4	6016.2	5870.9
4-8-4	5259.7	5818.4
0-8-8	5858.0	5750.3
6-8-4	5656.7	5458.7
8-4-4	5264.9	4329.0
8-12-4	6656.1	5688.6
8-0-4	3862.8	3410.9
8-8-0	5938.4	5770.9
0-12-0	6841.4	6367.6
0-8-0	6279.1	5613.0
0-0-8	3636.2	3803.4
8-8-8	6574.2	5868.1
0-0-0	4287.2	3857.4

*Nitrogen, phosporic acid, and potash in the order named.

TABLE 19.—EFFECT OF TOPDRESSING WITH VARYING AMOUNTS OF LIME ON NORFOLK VERY FINE SAND.

Pounds applied per acre			Yield
Dolomite	+	Superphosphate	pounds dry weight per acre
80	+	200	2095.7
160	+	200	2273.4
240	+	200	2517.8
320	+	200	2695.5
480	+	200	4124.7
960	+	200	3554.5
No treatment			1399.6

ent to 240 pounds of 20 percent superphosphate per acre. Combinations of phosphorous and potash, or phosphorous and nitrogen, or a complete fertilizer, produced somewhat lower yields than did phoshporous alone and at considerably higher cost. For example 400 lbs. 4 - 8 - 4 cost about twice as much as 400 pounds of 0 - 12 - 0, yet produced 1600 pounds less of dry matter per acre. No other treatment produced as much increase or as economical increase as 48 pounds of P_2O_5 per acre.

The limed plots in the test were treated with dolomitic limestone at the rate of 1000 pounds per acre. On the unfertilized checks, the limed plots produced about 400 pounds more dry matter, and on the 32-pound and 48-pound phosphorous plots, those limed produced about 500 pounds more dry matter per acre than those not limed.

The effect of the various elements, with and without lime, on the type and amount of growth will be seen from the accompanying photographs, figures 13, 14, 15 and 16. All close-up views of the sod were photographed from the same height.

Small Amount of Lime Advised

The data and the photographs show that phosphorous with small amounts of lime make the best pasture fertilization practice on these soils. Results shown in table 18 are substantiated in table 2, and definitely indicate that fertilization should be for the benefit of the legumes, thus allowing the pasture grasses to obtain their nitrogen from the legumes.

It should be pointed out that overliming is more easily done on the sandy types of soil than on those containing more silt or clay. For example, the amount of lime needed to neutralize (bring to a pH reading of 7.0) a Grenada silt loam with an acidity of pH 5.5, would when added to a Ruston fine sandy loam of the same degree of acidity cause the Ruston to become more than neutral (pH 8.2). The sandy soils also contain less minerals for plant growth, and nutrients in sandy soils are thus tied up in an unavailable form with less lime than is the case with silt or clay soils.

The good response of Norfolk soil to small quantities of lime, and the case of over-liming, may be shown by the yield of pasture clippings from a pasture growing on Norfolk very fine sand. A Carpetgrass-lespedeza hill pasture on this soil type in Pearl River county was topdressed in January 1940, with varying amounts of dolomitic limestone in combination with 200 pounds of 20 percent superphosphate. The dry matter produced per acre is shown in table 19.

These data show that topdressing with 1000 pounds of lime reduces pasture yields on Norfolk soil, while a 500-pound application of lime was highly beneficial. By comparing with the data in table 18 it will be noted that the amount of lime which reduced the yield on sandy soil produced an increase in

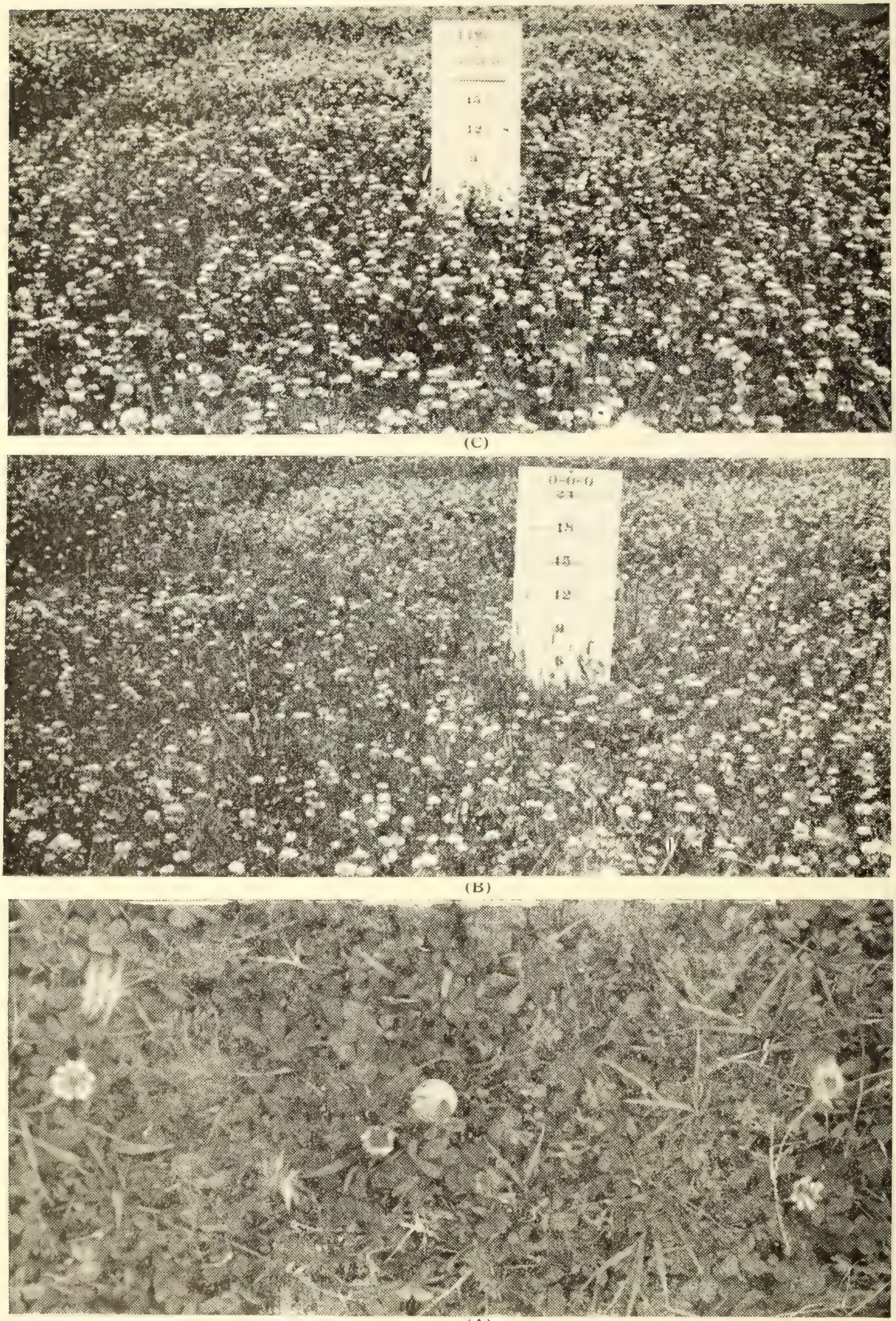
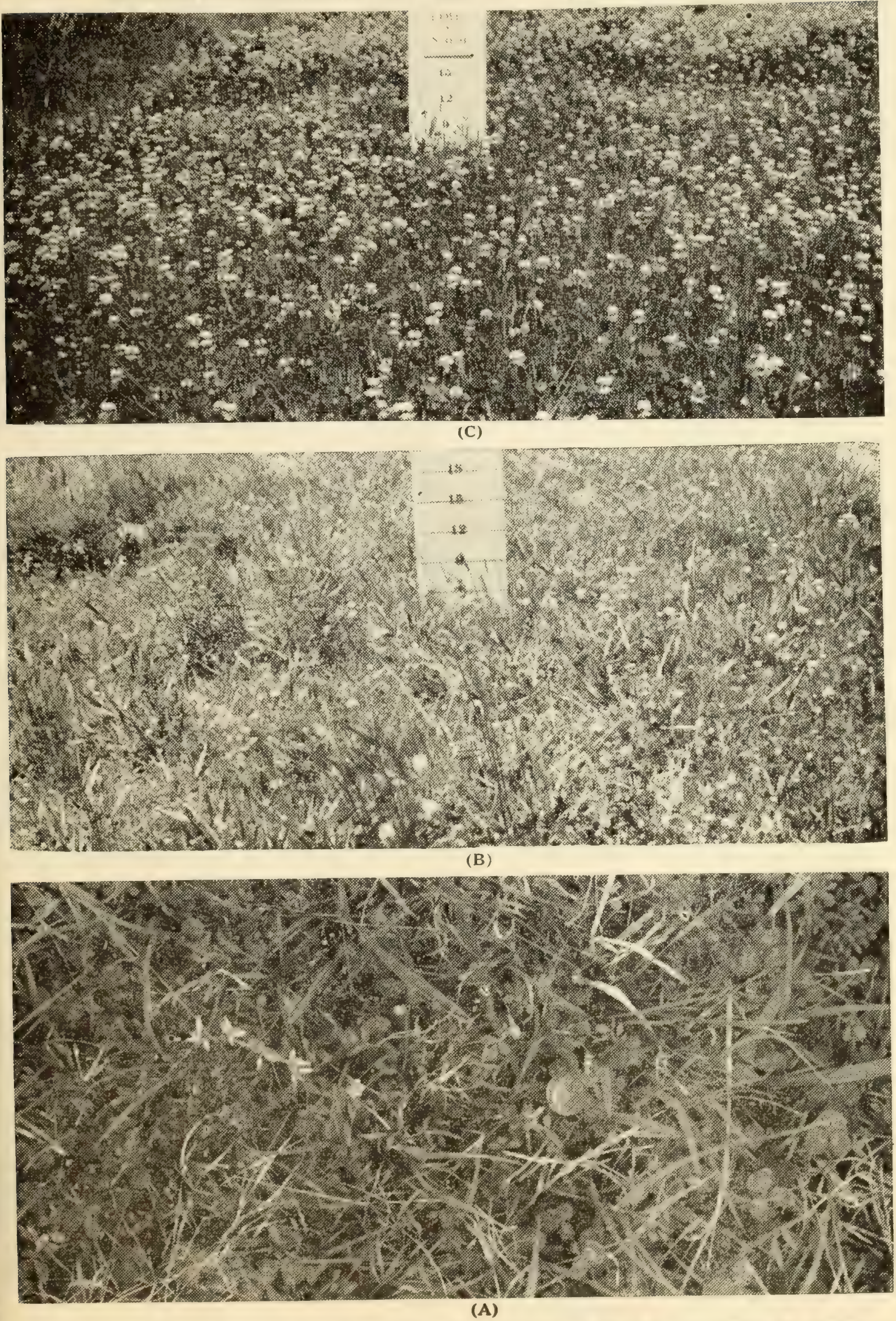


FIGURE 13.—Plot a. and b. receiving no treatment. Plot c. received lime. Note the percentage of grass and the increase in height due to lime.

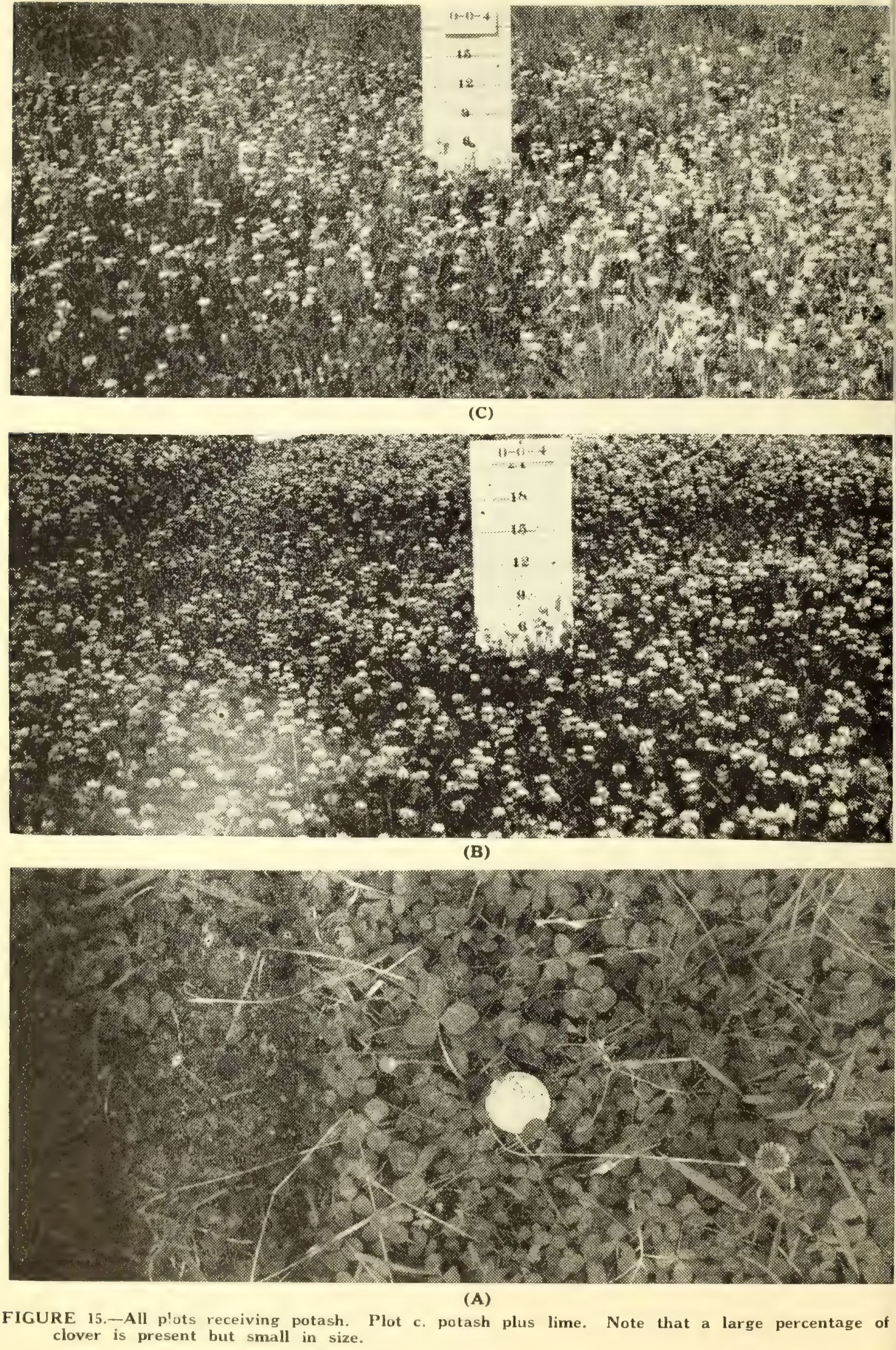


(C)

(B)

(A)

FIGURE 14.—All plots receiving nitrogen. Note the amount of grass in proportion to clover on nitrogen alone and the effect of lime (plot c.) on legume growth when used with nitrogen.


0-0-4
15
12
9
6
0-0-4
24
18
15
12
9
6

(C)

(B)

(A)

FIGURE 15.—All plots receiving potash. Plot c. potash plus lime. Note that a large percentage of clover is present but small in size.

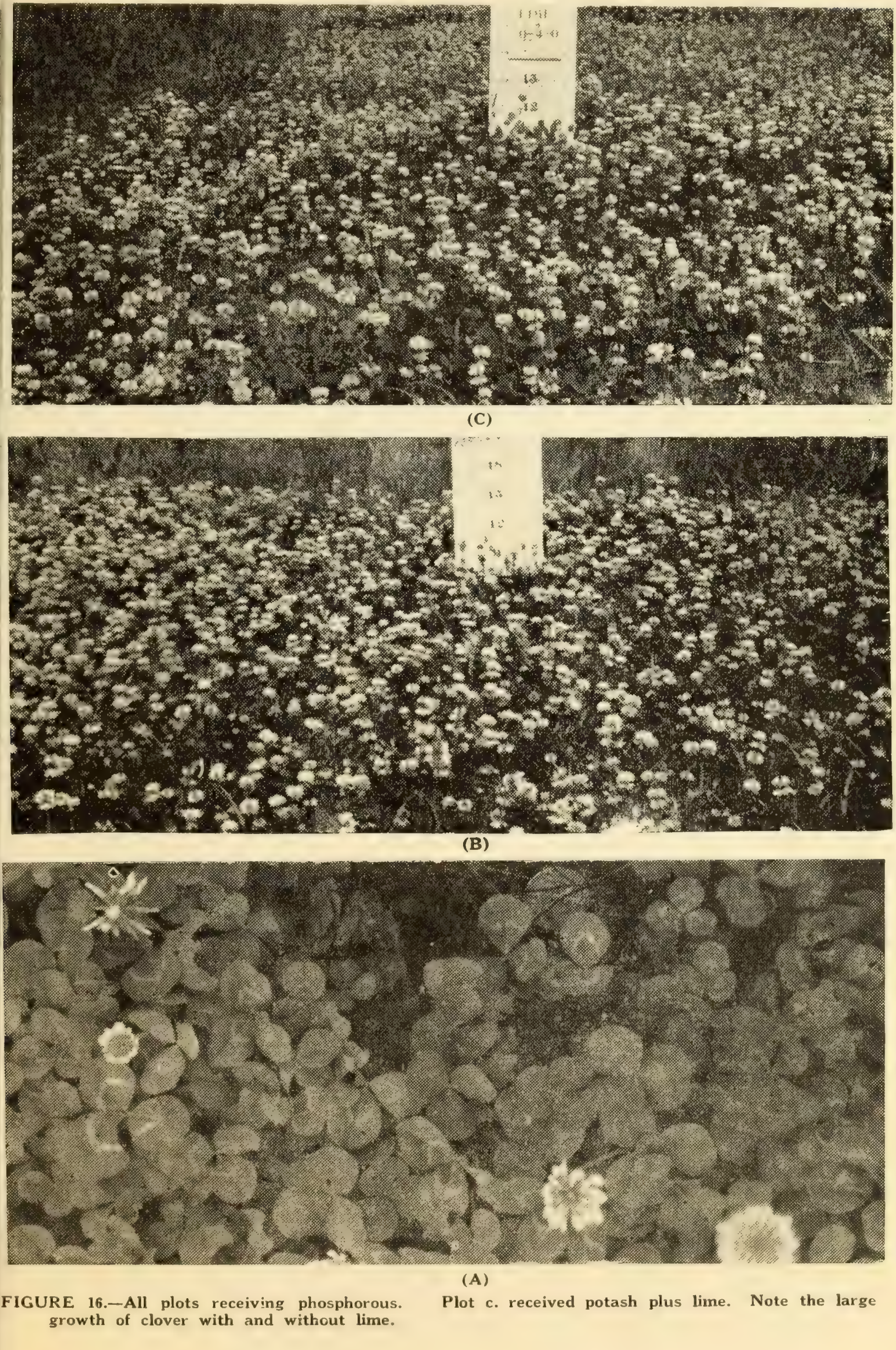


FIGURE 16.—All plots receiving phosphorous. Plot c. received potash plus lime. Note the large growth of clover with and without lime.

yield on a silt loam soil. It should be emphasized that these reductions occurred with topdressing without further treatment. Where land is being prepared for seeding or when lime is worked into the soil, it is likely that much greater quantities of lime would be required to produce the overliming effects.

Results from the experiments here reported have led to the recommendations that smaller, more frequent applications of lime (500 pounds to 1000 pounds) be used for pasture topdressing rather than an occasional large application of lime (2000 to 4000 pounds). Use lime with the objective of supplying plant food (calcium) rather than with the sole objective of correcting acidity.

The effect of basic slag is much the same as that of phosphate and lime on the sandy, as well as the silt or clay soil types, when pound for pound of available phosphoric acid are applied. The two-year average dry matter yield obtained from topdressing with comparable amount of basic slag and superphosphate and lime on Grenada silt loam are:

Treatment	**Dry matter lbs. per acre**
1000 pounds basic slag	4473.8
400 pounds 20% Super plus 1000 pounds lime	4618.9

These data indicate that the cost of material and its application would determine which (basic slag, or super plus lime) to apply to pastures. However, on soils of a low fertility and where the cost of materials is approximately the same, basic slag is preferred because it contains elements in addition to calcium and phosphorous.

On many soils—those that have been heavily cropped to lespedeza or other legumes, those where grazing has been practiced over a long period and legume growth is scant, or those of a low fertility—the application of potash materially increases the yield of pasture growth. Topdressing an established and heavily grazed pasture on Olivier (a second-bottom or terrace soil of the Brown Loam Region soil, gave the following two-year average results:

Treatment	**Dry matter lbs. per acre**
None	4442.3
100 pounds Muriate	5347.8
200 pounds 20% Super	5146.1
100 Muriate plus 200 Super	6597.5

These data show that soils that are low in potash or that have been grazed over a long period of time, give profitable response to potash applications. It will be noted that on this soil, potash was more the limiting factor for growth than was phosphorous. It will also be noted that it is necessary to apply potash under these conditions in combination with phosphorous to equal the production produced by phosphorous alone on Grenada soil (table 15.)

It may be pointed out that all pasture soils of the state are not as responsive to phosphatic fertilization as is the Grenada type. However, the general effect of phosphates is the same: an increase in the legume population and its growth. On many soils of the lower Coastal Plains area it will be necessary to apply lime, phosphorous, and potash to obtain a profitable stand of clover.

Temporary Pastures

Mississippi pastures have peaks of production during the spring and fall. Usually there is a let-down in pasture production during the mid-summer. The same number of animals adequately carried by a spring pasture would overgraze the same pasture during this summer period of lessened production. These periods will vary from season to season, but provision should be made to relieve the permanent pasture of this summer overgrazing. This may be done in several ways.

The seeding of the recommended pasture mixture will result in a more even month-by-month production of pasture forage. White Dutch clover will produce much longer through the spring than the other clovers with their determinate habit of growth, for its growth continues up into the summer until dry conditions prevail. Dallis produces more through the summer than does either Bermuda or Carpet grass. Furthermore, Dallis will be stimulated by the association with the clover and would therefore spread pasture production over a longer period because of this stimulation. The letdown period between the going-out of the spring clover and the coming-in of lespedeza is filled better by using Dallis than by any other of our summer grasses.

Fertilization materially aids in filling in slack grazing periods. Clover growth stimulated by fertilization begins earlier in the spring and again in the fall, thus lengthening the grazing period. Fertilization also greatly increases the amount of herbage produced throughout the season.

Crops grown for temporary or supplemental grazing is another means by which the low summer production may be helped. Lespedeza can well be used for this purpose and comparative yields, as hay, are shown in table 11. The comparative yields of other summer crops without fertilization which may be grazed during periods of slack pasture production are shown in the following table 20.

These data show that the tall growing crops yield best when grown in rows, so that some cultivation may be given. Weeds and grass reduce the yield when broadcast plantings are made, due to competition for moisture. Cattail Millet is better adapted to south Mississippi conditions than is Sudan grass because of the susceptibility of Sudan to leaf-spot diseases. Fields of lespedeza to be used as temporary pasture would furnish more grazing than the other crops. Especially is this true in the case of Lufkin, the prevailing soil of the Flatwoods area (table 11). On most Mississippi soils with good drainage, Kudzu seems particularly valuable as a temporary or supplemental pasture. A majority of the hill farms have areas that should be set to

TABLE 20.—COMPARATIVE YIELDS OF MISCELLANEOUS FORAGE CROPS

	Pounds dry weight per acre on soil type					
	Grenada		Lufkin		Ruston	
	Broadcast	Row Planted	Broadcast	Row Planted	Broadcast	Row Planted
Texas Seeded Sorghum	3744.2	6486.7	746.6	1170.8	750.1	2118.8
Early Amber Sorghum	2697.2	4543.0	921.7	1095.4	908.0	1829.2
Sagrain Sorghum	3313.2	4915.2	1081.6	1435.0	1204.1	2684.6
Orange Sorghum	3057.4	6870.6			1729.9	3117.8
Sudan Grass	2519.8	2564.3	570.2	1092.3	955.9	763.4
Cattail Millet	2713.3	2838.7	501.7	1244.1	1174.2	1928.6
Tennessee Millet	1828.3	1743.0	541.6	690.7	807.6	973.1
Otootan Soybeans	4123.5	4078.1	1073.0	1329.1	701.3	1013.0
Laredo Soybeans	3755.8	3679.7	654.8	1230.4	472.3	1408.9
Mamredo Soybean	4384.5	4133.3	633.5	1362.1	1374.2	1464.9
Brabham Cowpeas	1831.7	2530.3	902.7	2135.7	1439.1	2707.5
Iron Cowpeas	2685.3	2191.7	1584.5	1834.5	1652.1	2491.2

this crop for erosion control, as well as for the grazing or hay produced. The practice of controlled grazing of Kudzu would yield returns from those areas where none are now realized. Its particular value for erosion control should not obscure the fact that Kudzu yields best from productive soils, as do other crops.

Supplemental crops may also be used to good advantage during the winter months for grazing. The use of such temporary crops until the permanent pasture has made good growth in the spring will increase the production of the pasture. Early-fall sown crops as Hairy vetch in combination with one of the small grains, or Crimson clover or Winter Rye grass will furnish late fall and early spring grazing. The utilization of such winter crops is the only means by which Mississippi farmers can hope to approach the ideal of year-round pasturing. Production from even these crops will depend upon time of planting, soil fertility and climatic conditions.

Pasture Management

Several important points should be stressed concerning the management of pastures.

Pastures seeded to desirable plant mixtures should be grazed but little the first season, whether such pastures be new or old. Protection from grazing permits the establishment of the perennial crops and also the production of seed, both of which are important to obtain a full and thick sod. The mowing of weeds should go along with light grazing. It must be kept in mind that time is necessary for pasture establishment, even under favorable conditions.

After pastures have been cleared of weeds and new and desirable plants have been established and fertilized to their maximum profitable production, they should be kept at high production levels by management. Once these establishment factors are supplied, by far the principal factor in pasture management in Mississippi is the prevention of overgrazing. Overgrazing reduces the ground cover, thus permitting erosion to take place. Overgrazing results in severe selective grazing, and by thus promoting conditions favorable for weeds, the reseeding of desirable plants is prevented. When pastures are overgrazed for two or three seasons, the population of desirable plants is so reduced that it is necessary to begin over again the practices of establishment and improvement.

Pastures can also be undergrazed or undermowed. The effect of mowing or grazing upon the quality of pasture material produced has been shown. If not mowed, weeds or other native growth will make difficult the establishment of new seedings.

Another very important practice in pasture management is the spreading of accumulated animal droppings. This practice prevents the formation of "ungrazed islands" and the consequent uneven grazing. It also spreads this important pasture fertilizer which will stimulate summer grass and aid greatly in preventing the mid-summer let-down in production.

That manure helps mid-summer production may be shown by topdressing tests conducted on Paden soil in Tishomingo County. Yields obtained during July and August by means of movable cages are as follows:

Treatment	**Yield dry wt. per acre**	**Percent grazed**
None	1766	18
Manure	3063	69

These data show that applications of manure not only increases summer growth but that this growth is grazed much better. The vegetation on this pasture consisted principally of Dallis grass and lespedeza.

The importance or necessity of returning all animal manures back to the pasture is shown by data cited in U. S. D. A. Miscellaneous Publication 194, 'A Pasture Handbook," as follows:

"In producing 100 pounds of beef per acre, annually, approximately 3 pounds of nitrogen, 0.94 pound of phosphorous, and 0.17 pound of potassium are taken from the soil and retained in the carcass. Estimating that only one-half of the manure is returned to benefit the pasture, there is an additional loss of 12 pounds of nitrogen, 0.87 pound of phosphorous, and 9.96 pounds of potassium."

Cooperation in growing pasture and forage crops is acknowledged from: Holly Springs Branch Station, E. B. Ferris, superintendent; Raymond Branch Station; South Mississippi Branch Station, J. C. Robert, superintendent; Natchez Branch Station, S. P. Crockett, superintendent; West Point Experimental Field, T. F. Akers, Assistant Agronomist, U. S. D. A.; and to Marvin Gieger, Experiment Station chemist.

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The Influence on Cotton Production of Nitrogen, Phosphorus, and Potassium and Their Combination

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SUMMARY AND CONCLUSIONS

The results of 6 years of experimental work with cotton in the hill sections of the State on the influence of different fertilizer combinations, using nitrogen, phosphorus, and potassium, may be summarized as follows:

Cotton growing on soils of a sandy texture shows a greater response to fertilizer applications than does cotton growing on soils of a silt or clay texture. The profit from a complete fertilizer (400 pounds of 4-8-4) applied to six soils of a sandy texture averaged $6.86 per acre whereas, the profit from the same fertilizer applied to four soils of a silt or clay texture averaged only $1.61 per acre.

The importance of supplying nitrogen to cotton grown on both sandy soils, and silt and clay soils cannot be over-emphasized. The application of nitrogen in combination with phosphorus and potash increased the profit per acre in every test conducted on sandy soils, and in two of the tests conducted on silt or clay soils.

Phosphorus, applied in combination with nitrogen and potash, proved to be more profitable on soils of a sandy texture than on soils of a silt or clay texture. The average profit for this phosphorus application on sandy soils at six different locations was $3.66 per acre.

The application of potash in combination with nitrogen and phosphorus increased the profit on all of the sandy textured soils except one, while only one test conducted on silt or clay textured soils showed a profit as a result of the potash addition.

These results show that cotton growing on sandy soils responds profitably to the application of all three of the plant foods: nitrogen, phosphorus, and potassium; whereas, on the silt and clay soils the results present some question as to whether or not the application of both phosphorus and potassium in combination with nitrogen is profitable.

The importance of phosphorus and potassium may be determined by treating three small adjoining portions of the field as follows: one with the three plant foods nitrogen, phosphorus, and potassium; another with nitrogen and phosphorus, leaving potassium out of the fertilizer; and another with nitrogen and potassium, leaving phosphorus out of the fertilizer.

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The Influence On Cotton Production of Nitrogen, Phosphorus, and Potassium and Their Combination

By J. L. ANTHONY and JOHN PITNER,
Agronomy Department

In the economical production of cotton in Mississippi, the use of some commercial fertilizer is in most cases a necessity. The exact amount and kind which gives best results is dependent upon local conditions; such as, soil type, its previous treatment (some soils have been properly used and their plant foods have been conserved, while others have not been properly used and their plant foods have been lost), and the prevailing climatic conditions. A complete fertilizer, or that supplying each of the three most commonly deficient plant foods, nitrogen, phosphorus, and potassium, has been found to be the most profitable on some soils. On other soils combinations of two of the three plant foods, nitrogen, phosphorus, and potassium have been found to be the most profitable. In view of the possible money savings, it is highly important that the farmer know the combination of these elements most applicable to his farm.

When speaking of the soils in Mississippi, they are most commonly referred to as sands, silts, and clays. These are sub-divided into sandy loams, fine sandy loams, silt loams, clay loams, and other similar sub-divisions. It is not always an easy matter even for the soil specialist to separate soils into their finer subdivisions in the field, but it is a reasonably easy matter for any person to determine broadly whether soils are sands, silts, or clays. In the light of this, when possible, soils are grouped as such in this paper.

In 1934, the Mississippi Agricultural Experiment Station, in cooperation with the Tennessee Valley Authority, began field experiments to determine the influence of nitrogen, phosphorus, and potassium when applied together and when applied in different combinations using only two of the above mentioned three plant foods, on the production of cotton. These tests were located at many widely distributed places in the hill sections of the State, and on a number of soils which are believed to be representative of some of the more important soil types of Mississippi, outside the Delta area.

Purpose of Experiment

The Mississippi Station has conducted field experiments with fertilizers over a long period of years. In the main, such experiments have sought to determine the most profitable ratio of nitrogen, phosphorus, and potassium in fertilizer mixtures, and the most profitable rate of application. Results from these tests are the basis of the Station fertilizer recommendations which are published annually.

The experiments reported in this publication have an altogether different purpose. They seek to test whether one of the three elements (nitrogen, phosphorus, and potassium) may be left out of the mixture, to the end that the money thus saved may be more profitably invested.

Every effort was made to conduct these experiments under conditions and in line with fertilizer practices found on the average good farms. Several of the field tests were conducted in cooperation with farmers. The uniform application of 400 pounds per acre is perhaps close to the average amount of fertilizer applied to cotton in the hill section of the state. The 4-8-4 mixture (4 units of N, 8 units of P_2O_5, 4 units of K_2O) is by far the most popular grade of fertilizer used in Mississippi; approximately three-fourths of all complete fertilizer sold in the state is 4-8-4.

In the report which follows it will be observed that on most soils of a sandy texture a complete fertilizer is most profitable for cotton production, but that on many of the silt and clay soils either nitrogen or phosphorus or potash may be more profitably omitted from the formula. Since wide variations in soil types are found on many farms, in the silt and clay groups especially, farmers may desire to conduct tests of their own in order to further apply the results of experiments here reported to their own farms A method for conducting simple field experiments of this nature is outlined in a later portion of this report.

Materials Used

The experiments on the value of different combinations of nitrogen, phosphorus, and potassium on the yield of cotton were fertilized at the rate of 400 pounds per acre. The different combinations were:

4-8-4, which is commonly called a complete fertilizer because it supplies all of the three plant foods: nitrogen, phosphorus, and potassium;

0-8-4, which supplies phosphorus and potassium but does not supply nitrogen;

4-8-0, which supplies nitrogen and phosphorus but does not supply potassium;

4-0-4, which supplies nitrogen and potassium but does not supply phosphorus.

Ninety percent of the nitrogen used in the above combinations was obtained from ammonium sulphate and 10 percent from cotton seed meal. The phosphorus used in the 4-8-4 combination was obtained from three sources; namely, superphosphate, monocalcium phosphate, and dicalcium phosphate. The yield of seed cotton obtained from these three sources was approximately the same, so superphosphate will be used to calculate the profit or loss obtained from the application of phosphorus. In the combinations 0-8-4 and 4-8-0, 20 percent superphosphate was used as the source of phosphorus. Potassium was obtained from 50 percent muriate of potash.

In calculating the profit or loss from the application of 400 pounds 4-8-4, 0-8-4, 4-0-4 and 4-8-0 over the no-fertilizer or check plot, 1939-1940 average prices of the different fertilizer materials from several Mississippi fertilizer companies were used. The cost of phosphorus was based on the price of 20% superphosphate.

The prices of the different fertilizer materials were as follows:

Superphosphate, 20% available P_2O_5—$20.50 per ton.

Muriate of potash, 50% K_2O—$41.00 per ton

Ammonium sulfate, 20.5% Nitrogen—$36.00 per ton.

Cottonseed meal, 6.5% Nitrogen—$30.00 per ton.

4-8-4 (when mixed)—$19.65 per ton.

Cost of Fertilizers

In order to obtain a mixture equal in plant food content to 400 pounds of 4-8-4 bought commercially in sacks, the following amounts of the above listed materials were weighed and mixed:

70.2	pounds of ammonium sulfate
24.6	pounds of cottonseed meal
160.0	pounds of superphosphate
32.0	pounds of muriate of potash
286.8	pounds total weight

Even though the total weight of this mixture amounts to only 286.8 pounds, it contains the same amount of plant food as 400 pounds of 4-8-4 bought in sacks commercially. It contains 4 x 4-8-4, or 16 pounds nitrogen (N), 32 pounds phosphate (P_2O_5), and 16 pounds potash (K_2O).

In some mixed fertilizers the other 113.2 pounds consists of some inert material, such as sand; while in those mixed fertilizers labeled "non-acid forming," part and in some instances all of the 113.2 pounds consists of some form of lime.

The other combinations are obtained as follows: in 0-8-4, ammonium sulfate and cotton seed meal are left out of the mixture; in 4-8-0, muriate of potash is left out of the mixture; in 4-0-4, superphosphate is left out of the mixture.

The cost of 400 pounds of each of the different combinations in dollars and cents and the number of pounds of seed cotton valued at 3½c per pound to equal this cash cost, is as follows:

COST IN MONEY OR IN SEED COTTON OF 400 POUNDS FERTILIZER

4-8-4	$3.93	or	112 lbs. of seed cotton
0-8-4	2.30	or	66 lbs. of seed cotton
4-8-0	3.28	or	94 lbs. of seed cotton
4-0-4	2.28	or	65 lbs. of seed cotton

Increased crop yields due to fertilizer is not all profit. An exact definition of profit would take into account the extra labor in applying the fertilizer and in harvesting and moving the crop to market as well as the cost of fertilizer applied Since no more labor is involved in applying a profitable fertilizer mixture than in applying an unprofitable mixture, and since the value of cotton seed is very roughly equal to the cost of harvesting and ginning, this report is simplified by omission of labor cost. It is further simplified by the calculation of the amount of seed cotton required to pay for the fertilizer application.

NITROGEN, PHOSPHORUS, AND POTASSIUM ON SANDY SOILS

Six field tests were conducted on soils of sandy texture during the progress of the experiment, on five soils: Atwood Cahaba, Savannah, Ruston, and Kalmia These soils are fairly representative of the sandy soils of Mississippi and include three upland soils and two terrace soils, in locations ranging from near extreme northeast Mississippi to near extreme south Mississippi. One of the tests was located at a sub-station and five were conducted on farms of cooperating farmers.

Results of the fertilizer experiments are presented by separate locations and are then summarized.

Atwood Fine Sandy Loam

W. N. Hutchinson Farm, Caledonia

Atwood soils are dark brown to gray upland soils with red subsoils, gently rolling to rather steep and hilly. They are found mostly in northeast Mississippi

A complete fertilizer was most profitable under the conditions of this test (table 1). 400 pounds of 4-8-4 increased the yield 452 pounds of seed cotton over the no-fertilizer check plot. This treatment cost 112 pounds of seed cotton, so that the profit was 340 pounds net increase, valued at $11.90.

When nitrogen was omitted and 400

TABLE 1—COTTON FERTILIZATION: W. N. HUTCHINSON FARM, CALEDONIA

Atwood Fine Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	637	452	112	340	$11.90
0-8-4 (No nitrogen)	363	178	66	112	3.92
4-8-0 (No potash)	531	346	94	252	8.82
4-0-4 (No posphate)	318	133	65	68	2.38
No fertilizer	185	-----	-----	-----	-------

TABLE 2—COTTON FERTILIZATION: W. R. WALKER FARM, COLLINSVILLE

Cahaba Fine Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	668	345	112	233	08.16
0-8-4 (No nitrogen)	404	81	66	15	0.53
4-8-0 (No potash)	543	220	94	126	4.42
4-0-4 (No phosphate)	559	236	65	171	5.99
No fertilizer	323	----	----	----	----

pounds of 0-8-4 applied, the yield was 178 pounds more than the unfertilized plot and since the 0-8-4 treatment cost 66 pounds of seed cotton, the net increase of 112 pounds showed a profit of $3.92. This profit from 0-8-4 is, however, $7.98 less than the profit from the application of 400 pounds of 4-8-4.

When potash was omitted and 400 pounds of 4-8-0 applied, the yield was 346 pounds more of seed cotton than the unfertilized plot; and since the 4-8-0 treatment cost 94 pounds of seed cotton the net increase of 252 pounds showed a profit of $8.82. This profit is $3.02 less than the profit from 400 pounds of 4-8-4

When phosphorus was omitted and 400 pounds of 4-0-4 applied, there was an increase in yield of 133 pounds of seed cotton. Since this treatment cost 65 pounds of seed cotton, there was a net increase of 68 pounds, which shows a profit of $2.38. This profit, however, is $9.52 less than the profit from the application of 400 pounds 4-8-4.

Cahaba Fine Sandy Loam

W. R. Walker Farm, Collinsville

Cahaba soils are gray to brownish-color soils with reddish-brown subsoils. Cahaba is a terrace or "second bottom" soil, and is widely distributed over the state.

Under the conditions of this test, (table 2), 400 pounds of 4-8-4 was the most profitable fertilizer, yielding 345 pounds more than the unfertilized check, and since this treatment cost 112 pounds of seed cotton, there was a net increase of 233 pounds. This represents a profit of $8.16 from the use of 400 pounds of 4-8-4.

When nitrogen was omitted and 400 pounds of 0-8-4 was applied, the increase in yield over the no-fertilizer plot was 81 pounds. Since the 0-8-4 treatment cost 66 pounds, there resulted only 15 pounds net increase, valued at 53 cents. This is $7.63 less than the profit gained from the application of 400 pounds 4-8-4.

When potash was omitted and 400 pounds of 4-8-0 was applied, the yield was 220 pounds more than the unfertilized plot, and since the 4-8-0 treatment cost 94 pounds of seed cotton, the net increase of 126 pounds showed a profit of $4.42. This is, however, $3.74 less than the profit from 400 pounds 4-8-4.

When phosphorus was omitted and 400 pounds 4-0-4 applied, the yield was 236 pounds more than the check plot. This treatment cost 65 pounds of seed cotton, and the net increase of 171 pounds showed a profit of $5.99. The profit from this treatment is $2.17 less than the profit from the 4-8-4 treatment.

Savannah Very Fine Sandy Loam

J. R. Vaughn Farm, Shannon

Savannah soils are yellowish-brown upland soils with yellow subsoils of somewhat limited distribution in northeast Mississippi. They may be level, gently rolling or rolling.

TABLE 3—COTTON FERTILIZATION: J. R. VAUGHN FARM, SHANNON
Savannah Very Fine Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	700	291	112	179	$6.27
0-8-4 (No nitrogen)	619	210	66	144	5.40
4-8-0 (No potash)	689	280	94	186	6.51
4-0-4 (No phosphate)	603	194	65	129	4.52
No fertilizer	409	---	-----	------	--------

In this test (table 3), an application of 400 pounds of 4-8-4 increased the yield 291 pounds over the check plot, and since this treatment cost 112 pounds of seed cotton, the net increase of 179 pounds resulted in a profit of $6.27.

With the application of 400 pounds of 0-8-4, nitrogen being omitted, the yield was 210 pounds more than the no-fertilizer plot; and since this treatment cost 66 pounds of seed cotton, the net increase was 144 pounds, which shows a profit of $5.40. This profit, however, is $1.23 less than the profit from the application of 400 pounds of 4-8-4.

When potash was omitted and 400 pounds of 4-8-0 applied, the yield was 280 pounds more than the unfertilized plot. This treatment cost 94 pounds of seed cotton so the net increase was 186 pounds. This represents a profit of $6.51, which is 24 cents higher than the profit received from the application of 400 pounds of 4-8-4.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the increase in yield was 194 pounds over the no-fertilizer plot; and since this treatment cost 65 pounds of seed cotton, the net increase of 129 pounds showed a profit of $4.52 This profit from 4-0-4 is $1.99 less than the profit from the 400 pounds of 4-8-0 treatment, which yielded the highest profit of any treatment in this test.

Ruston Fine Sandy Loam

T. A. Coleman Farm, Weir

Ruston soils are grayish-brown upland soils with brown-red subsoil. They are widely distributed in the hill section of Mississippi and range from almost level to steeply rolling.

The data in table 4 show a complete fertilizer was most profitable. 400 pounds of 4-8-4 increased the yield 331 pounds seed cotton over the no-fertilizer check plot. This treatment cost 112 pounds seed cotton, so that the profit was 219 pounds net increase, valued at $7.67.

The omission of nitrogen and the application of 400 pounds of 0-8-4 resulted in an increase in yield of 135 pounds over the unfertilized plot, and since the 0-8-4 treatment cost 66 pounds of seed cotton, the net increase of 69 pounds showed a profit of $2.42. This profit from 0-8-4 is $5.28 less than the profit from the application of 400 pounds 4-8-4.

When potash was omitted and 4-8-0 applied, the increase in yield of seed cotton over the no fertilizer check was 231 pounds. The cost of this treatment was 94 pounds of seed cotton, so the net increase of 137 pounds showed a profit of $4.80. However, the profit from 400 pounds of 4-8-4 was $2.87 more than this treatment.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the increase in

TABLE 4—COTTON FERTILIZATION: T. A. COLEMAN FARM, WEIR

Ruston Fine Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	751	331	112	219	$7.67
0-8-4 (No nitrogen)	555	135	66	69	2.42
4-8-0 (No potash)	651	231	94	137	4.80
4-0-4 (No phosphate)	658	238	65	173	5.96
No fertilizer	420	—	—	—	—

yield was 238 pounds over the no-fertilizer plot; and since this treatment cost 65 pounds of seed cotton, the net increase of 173 pounds showed a profit of $5.96. This profit from 4-0-4 is $1.71 less than the profit from the 400 pounds of 4-8-4 treatments

South Mississippi Branch Station, Poplarville

Under the conditions of this test (table 6) the application of fertilizer resulted in very small profits, and even losses. The application of 400 pounds of 4-8-4 on this Ruston soil at Poplarville resulted in an increase in yield of 121 pounds over the no fertilizer plot. This treatment cost 112 pounds of seed cotton, so that the profit was 9 pounds, valued at 32 cents.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the increase in yield over the check plot was only 2 pounds, and since this treatment cost 66 pounds of seed cotton, there was a loss of $2.24.

When potash was omitted and 400 pounds of 4-8-0 applied, the yield was 96 pounds more than the unfertilized plot, and since this treatment cost 94 pounds of seed cotton, the net increase of 2 pounds showed a profit of only 7 cents.

The application of 400 pounds of 4-0-4, phosphorus being omitted, resulted in an increase in yield of 67 pounds of seed cotton. This treatment cost 65 pounds, so that a profit of only 7 cents was realized.

Kalmia Fine Sandy Loam

H. Q. Brooks Farm, Smithville

Kalmia soils are gray to pale yellow terrace soils with yellow subsoils, level to gently rolling and are widely distributed in hill sections of Mississippi.

The results in table 5 show that 400 pounds of 4-8-4 was the most profitable fertilizer. This treatment increased the yield 294 pounds of seed cotton, and since this treatment cost 112 pounds of seed

TABLE 5—COTTON FERTILIZATION: H. Q. BROOKS FARM, SMITHVILLE
Kalmia Fine Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	859	294	112	182	$6.37
0-8-4 (No nitrogen)	687	122	66	56	1 96
4-8-0 (No potash)	724	159	94	65	2.38
4-0-4 (No phosphate)	637	72	65	7	0.25
No fertilizer	565	----	----	----	--------

TABLE 6—COTTON FERTILIZATION: SOUTH MISSISSIPPI BRANCH STATION
Ruston Sandy Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit* per acre
4-8-4	570	121	112	9	$0.32
0-8-4 (No nitrogen)	443	2	66	—64	—2.24
4-8-0 (No potash)	537	96	94	2	.07
4-0-4 (No phosphate)	508	67	65	2	.07
No fertilizer	441	----	----	----	--------

*Minus sign indicates loss.

cotton, the profit was 182 pounds net increase, valued at $6.37.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the yield was 122 pounds more than the no fertilizer plot; and since this treatment cost 66 pounds of seed cotton, the net increase of 56 pounds showed a profit of $1.96. This profit is $4.41 less than the profit from the application of 400 pounds of 4-8-4.

The omission of potash and the application of 400 pounds of 4-8-0 resulted in an increase in yield of 159 pounds over the unfertilized check. This treatment cost 94 pounds of seed cotton, so there was a net increase of 65 pounds, valued at $2.28. The profit received from the 400 pounds of 4-8-4 treatment was $4.09 more than the profit received from the application of 400 pounds of 4-8-0.

When phosphorus was omitted and 400 pounds of 4-8-4 was applied, the yield was 72 pounds more than the unfertilized plot, and since the 4-0-4 treatment cost 66 pounds of seed cotton, the net increase was 7 pounds, which shows a profit of 25 cents. This profit is $6.12 less than the profit from the 400 pounds of 4-8-4 treatment.

Summary of Fertilizer Tests On Sandy Soils

The weighted average of these test (table 7) show that a complete fertilizer was most profitable under the conditions of these tests. 400 pounds of 4-8-4 increased the yield 308 pounds of seed cotton over the no-fertilizer check. This treatment cost 112 pounds of seed cotton, so that the profit was 196 pounds, valued at $6.86.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the yield was 120 pounds more than the unfertilized plot, and since the 0-8-4 treatment cost 66 pounds of seed cotton, the net increase of 54 pounds showed a profit of $1 89. This profit from 0-8-4 is $4.97 less than the profit from 400 pounds of 4-8-4.

The omission of potash from the fertilizer and the application of 400 pounds of 4-8-0 resulted in an increase of 223 pounds of seed cotton over the unfertilized plot. This treatment cost 94 pounds of seed cotton, so that the profit was 129 pounds net increase, valued at $5.52. The profit from this treatment is $1.34 less than the profit from 400 pounds of 4-8-4.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the yield was 157 pounds more than the no-fertilizer plot. Since this treatment cost 65 pounds of seed cotton, the net increase of 92 pounds showed a profit of $3.22. This profit from 4-0-4 is, however, $3.64 less than the profit from 400 pounds of 4-8-4

TABLE 7—WEIGHTED AVERAGES OF COTTON FERTILIZER: TESTS ON SANDY SOILS

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	698	308	112	196	$6.86
0-8-4 (No nitrogen)	510	120	66	54	1.89
4-8-0 (No potash)	613	223	94	129	5.52
4-0-4 (No phosphate)	547	157	65	92	3.22
No fertilizer	390	—	—	—	—

NITROGEN, PHOSPHORUS, POTASSIUM ON SILT AND CLAY SOILS

Four tests of the value of nitrogen, phosphorus, and potash were conducted on soils fairly representative of the silt and clay soils of Missssippi.

Two of these tests were located in the "black prairie" area and included a test on a mixture of Houston and Sumpter clay soils, both representative of the black land prairie. The second test was on Oktibbeha clay, representative of the redland adjacent to the prairie.

Two of the tests were located in the brown loam region: one on Grenada silt loam, a typical upland brown loam soil; the other on Olivier silt loam, a representative terrace soil, also of the brown loam.

The tests were located at West Point, Columbus, Holly Springs, and Raymond.

Houston and Sumpter Clay

West Point Forage Crops Field, West Point

Houston and Sumpter clay soils are light brown to grayish-black or grayish-yellow upland soils with greenish-yellow or brownish-colored subsoils. Both are common to the "black prairie" area, and are high-lime soils. Sumpter is thought to be an eroded phase of Houston.

In a test conducted on Houston and Sumpter clay at the West Point Forage Crops Field (table 8), losses resulted with the application of any commercial fertilizer.

When 400 pounds of 4-8-4 was applied, the yield was increased 50 pounds of seed cotton over the no-fertilizer check; but since this treatment cost 112 pounds of seed cotton, the increase in yield lacked 62 pounds of seed cotton of paying for the fertilizer treatment, so there was a loss of $2.17.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the yield was 10 pounds more than the unfertilized check; but since this treatment cost 66 pounds of seed cotton, the increase in yield lacked 56 pounds of seed cotton paying for the fertilizer treatment so there was a loss of $1.96.

The application of 400 pounds of 4-8-0, potash omitted, gave an increase of 82 pounds of seed cotton over the no-fertilizer check. This treatment cost 94 pounds of seed cotton, so the increase in yield lacked 10 pounds of seed cotton paying for the fertilizer treatment. This resulted in a loss of 42 cents.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the yield was 41 pounds more than the unfertilized check; but since this treatment cost 65 pounds of seed cotton, the increase in yield lacked 24 pounds of seed cotton paying for the fertilizer treatment so there was a loss of 84 cents.

TABLE 8—COTTON FERTILIZATION: WEST POINT FORAGE CROPS FIELD
Houston and Sumpter Clay

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit* per acre
4-8-4	544	50	112	—62	$—2 17
0-8-4 (No nitrogen)	504	10	66	—56	—1.96
4-8-0 (No potash)	576	82	90	—12	—0.42
4-0-4 (No phosphate)	535	41	65	—24	—0.84
No fertilizer	494	——	——	——	——

*Minus sign indicates loss.

Oktibbeha Clay

J. E. Gilliam Farm, Columbus

Oktibbeha clay is a brownish-red upland soil with yellow mottled subsoil, locally known as "Red Prairie" or "Post-Oak" and is found mainly in close proximity to the black prairie soil. However, Oktibbeha soils are acid.

The results from a test on Oktibbeha clay on the farm of J. E. Gilliam, Columbus, Mississippi, showed 4-8-0 to be the most profitable combination under conditions of the test. Details are shown in table 9.

When a complete fertilizer, 400 pounds of 4-8-4, was applied, the increase in yield was 207 pounds of seed cotton over the no-fertilizer check. Since this treatment cost 112 pounds of seed cotton, there was a net increase of 95 pounds, valued at $3.33.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the yield was 65 pounds more than the no-fertilizer plot; but since an increase of 66 pounds was necessary to pay for the fertilizer treatment, there was a loss of 3½ cents.

When potash was omitted and 400 pounds of 4-8-0 applied, the yield was 257 pounds more than the unfertilized plot. This treatment cost 94 pounds of seed cotton, consequently there was a net increase of 163 pounds valued at $5.71. The profit from the 4-8-0 treatment was $2.38 more than that secured from the 4-8-4 treatment.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the increase was 151 pounds over the no fertilizer plot. This treatment cost 65 pounds of seed cotton, so that the net increase was 86 pounds, valued at $3.01.

Grenada Silt Loam

Holly Springs Branch Station, Holly Springs

Grenada silt loam is a light brown upland soil of wind-blown origin, with yellowish-brown subsoil. It is gently rolling to steeply rolling and is a principal soil of the brown loam region, which borders along the Mississippi-Yazoo delta throughout Mississippi.

From the results of a test on Grenada silt loam at the Holly Springs Branch Station, Holly Springs, Mississippi, a complete fertilizer was the most profitable. Detailed results are shown in table 10. 400 pounds of 4-8-4 increased the yield 280 pounds over the no-fertilizer plot; and since this treatment cost 112 pounds of seed cotton, there was a net increase of 168 pounds, valued at $5.88.

When 400 pounds of 0-8-4 was applied, the increase was 192 pounds over the unfertilized plot. This treatment cost 66 pounds of seed cotton, so that the net in-

TABLE 9—COTTON FERTILIZATION: J. E. GILLIAM FARM, COLUMBUS

Oktibbeha Clay

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit* per acre
4-8-4	539	207	112	95	$3.33
0-8-4 (No nitrogen)	397	65	66	—1	—.03½
4-8-0 (No potash)	589	257	94	163	5.71
4-0-4 (No phosphate)	483	151	65	86	3.01
No fertilizer	332	—	—	—	—

*Minus sign indicates loss.

crease of 126 pounds showed a profit of $4.41. This profit is, however, $1.47 less than the profit from the 4-8-4 treatment.

The omission of potash and the application of 400 pounds of 4-8-0 resulted in an increase in yield of 191 pounds over the no-fertilizer plot. Since this treatment cost 94 pounds of seed cotton, there was a net increase of 97 pounds, valued at $3.40. This profit is $2.53 less than that secured from 400 pounds of 4-8-4.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the yield was 225 pounds more than the no-fertilizer plot. This treatment cost 65 pounds of seed cotton, so that the net increase was 160 pounds, valued at $5.60. The profit from this treatment is only 28 cents less than that secured from 400 pounds of 4-8-4.

Olivier Silt Loam

Raymond Branch Station, Raymond

Olivier silt loam is a brownish-gray terrace soil with yellow subsoil. It is commonly found in second bottoms of the brown loam region.

In a test on Olivier silt loam at the Raymond Branch Experiment Station, Raymond, Mississippi, the increase in yield of seed cotton for the different fertilizer treatments was not enough to pay for the fertilizer treatment. Full information is shown in table 11.

The application of 400 pounds of 4-8-4 increased the yield 85 pounds of seed cotton over the no-fertilizer plot, but since an increase of 112 pounds of seed cotton was required to pay for the fertilizer

TABLE 10—COTTON FERTILIZATION: HOLLY SPRINGS BRANCH STATION
Grenada Silt Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	1386	280	112	168	$5.88
0-8-4 (No nitrogen)	1298	192	66	126	4.41
4-8-0 (No potash)	1297	191	94	97	3.40
4-0-4 (No phosphate)	1331	225	65	160	5.60
No fertilizer	1106	—	—	—	—

TABLE 11—COTTON FERTILIZATION: RAYMOND BRANCH STATION, RAYMOND
Olivier Silt Loam

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit* per acre
4-8-4	1117	85	112	—27	$—0 95
0-8-4 (No nitrogen)	1039	7	66	—59	—2.07
4-8-0 (No potash)	1116	84	94	—10	—0.35
4-0-4 (No phosphate)	1067	35	65	—30	—1.05
No fertilizer	1032	—	—	—	—

*Minus sign indicates loss.

treatment, a loss of 95 cents resulted.

The omission of nitrogen from the fertilizer and the application of 400 pounds of 0-8-4 increased the yield only 7 pounds over the unfertilized; but since this treatment cost 66 pounds of seed cotton, the increase in yield of seed cotton as a result of the fertilizer application lacked 59 pounds paying for the fertilizer treatment so there was a loss of $2.07.

When potash was omitted and 400 pounds of 4-8-0 applied, the increase was 84 pounds of seed cotton, but since this treatment cost 94 pounds, the increase in yield lacked 10 pounds paying for it, so there was a loss of 35 cents.

The application of 400 pounds of 4-0-4 resulted in an increase in yield of 30 pounds of seed cotton over the no-fertilizer plot, but since 65 pounds of seed cotton are required to pay for this treatment, there was a loss of $1.05.

It will be observed by reference to table 11 that the Olivier soil used in this test was of such fertility that it yielded almost a bale of cotton per acre without fertilization. Other experiments have indicated profit from fertilizer for cotton on Olivier and similar terrace soils of the Brown Loam Region.

Average of Tests on Silt and Clay Soils

The weighted average of all tests on silt and clay soils (table 12) show that 400 pounds of 4-8-0 was the most profitable under these conditions. 400 pounds of 4-8-0 increased the yield 153 pounds of seed cotton, and since this treatment cost 94 pounds of seed cotton, there was a net increase of 59 pounds, valued at $2.07.

When a complete fertilizer was applied, 400 pounds of 4-8-4, the yield was 155 pounds more than the unfertilized check, and since this treatment cost 112 pounds, there was a net increase of 43 pounds, valued at $1.61. This profit is 46 cents less than that secured from 400 pounds of 4-8-0.

When nitrogen was omitted and 400 pounds of 0-8-4 applied, the yield was 68 pounds seed cotton over the no-fertilizer plot. This treatment cost 66 pounds, so that the net increase was 2 pounds, valued at 7 cents. The profit from this treatment is $2.00 less than that secured from 400 pounds of 4-8-0.

When phosphorus was omitted and 400 pounds of 4-0-4 applied, the yield was 113 pounds more than the no-fertilizer plot, and since this treatment cost 65 pounds of seed cotton, there was a net increase of 48 pounds, valued at $1.68.

TABLE 12—WEIGHTED AVERAGE OF COTTON FERTILIZER: TESTS ON SILT AND CLAY SOILS

Treatment — 400 pounds	6-year average yield in pounds of seed cotton	Increase over no fertilizer in pounds of seed cotton	Cost of fertilizer treatment in pounds of seed cotton	Net increase over no fertilizer in pounds of seed cotton	Profit per acre
4-8-4	896	155	112	43	$1.61
0-8-4 (No nitrogen)	809	68	66	2	0.07
4-8-0 (No potash)	894	153	94	59	2.07
4-0-4 (No phosphate)	845	113	65	48	1.68
No fertilizer	741	—	—	—	—

INDIVIDUAL FIELD TESTS TO DETERMINE NEEDS

Data presented in this paper concerns the value of nitrogen, phosphorus, and potassium for cotton production on representative soils of the hill section of Mississippi. These data show:

1. That most, though not all, soils of sandy texture need nitrogen, phosphorus, and potassium for maximum economic cotton production;

2. That soils of silt or clay texture vary widely in response to combinations of fertilizer elements, some requiring NPK, (nitrogen, phosphorus, and potash) some PK, and NK, for best results.

Since these wide differences exist between soils, and may exist between soils on any one farm, all fertilizer recommendations must be of a general nature and must be adapted by the farmer to his own specific requirements and conditions.

To this end, farmers may desire to conduct simple field tests to more specifically determine their fertilizer needs. The following suggestions may be of assistance:

1. Select locations for the experiment that are average for the field. Probably three separate tests should be made, at least one for every soil type visibly different from the others.

2. On each location lay off eight rows each row 3½ feet wide and 62 feet long, each pair of rows will contain approximately 1/100 of an acre.

3. In each of the locations apply fertilizer as follows:

Rows one and two, 4-8-4. Made up of one pound nitrate of soda, two pounds 16% superphosphate (or 1.6 pounds 20%) and one-third pound 50% muriate of potash.

Rows three and four, 0-8-4. Made up of two pounds of 16% superphosphate (or 1.6 pounds 20%) and one-third pound 50% muriate.

Rows five and six, 4-0-4. Made up of one pound nitrate of soda, and one-third pound 50% muriate.

Rows seven and eight, 4-8-0. Made up of one pound nitrate of soda, and two pounds 16% superphosphate (or 1.6 pounds of 20%.)

Each of the pair of rows contain 1/100 acre and is fertilized at the rate of 400 pounds per acre of 4-8-4, 0-8-4, 4-0-4, and 4-8-0 respectively.

If information is wanted on the basis of 600 pounds fertilizer per acre, add "half as much again"; if wanted on the basis of 800 pounds per acre, double quantities of fertilizer above.

4. Cultivate and otherwise handle the experiment crop exactly as the main crop is handled. To "pet" or neglect the experiment would make it worthless.

5. Pick and weigh separately cotton produced on each pair of similarly fertilized rows. After picking is completed multiply total figures by 100 and the results will be the approximate number of pounds of cotton produced per acre.

6. Calculate results by placing market value of the acre yield of each two row treatment, subtracting cost of fertilizer (shown in this bulletin) and the results will be profit or loss.

Bulletin No. 358 May, 1941

MISS. EXP[illegible] [illegible]
STATE COLLEGE, MISS.

Sweetpotato Plant Spacing

By

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Mississippi State College
MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
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SET PLENTY OF PLANTS TO SECURE GOOD YIELDS

There is evidently a difference in the response of sweetpotatoes to spacing on soils of different fertility levels or in connection with different rates of fertilizer application. There is also some evidence that there is a relationship between the date of planting and the spacing, and the Mississippi Station has experiments under way which compare, with Porto Rico and Triumph, six different spacings planted at five different times from early April to late June.

In Mississippi Farm Research for January 1941 the fertilizer recommendations for use with sweetpotatoes in the various regions of the state were given as follows:

Delta Area: Nitrogen only, 24 to 36 pounds to the acre of actual nitrogen.

Hill Soils: 6-8-4 or 6-8-8, 800 to 1000 pounds to the acre.

Upland Valley Soils: 4-8-8, 500 to 600 pounds to the acre.

If growers make these recommended fertilizer applications and plant the crop of Porto Rico potatoes between May 15 to June 15, the plants should be spaced approximately 12 inches apart in rows having a width from 3 to 4 feet, depending on the convenience to the grower. Earlier plantings may be spaced wider, if the grower can make good use of over-size potatoes. If planted later, they may be spaced as close as 8 inches.

In growing the Triumph in the starch factory area in South Mississippi, the available information indicates that spacings from 12 to 18 inches are equally profitable, considering the plants worth one dollar a thousand and assuming machine planting. If plants are plentiful and therefore cheap, and if facilities are available for machine transplanting and applying fertilizer at the same operation, the grower can well afford to space closer than 18 inches.

Growers should consider the fertility of their land, its water holding capacity, and whether the crop will suffer from weed competition, in deciding upon a spacing practice.

In many cases the total yield of Triumph sweetpotatoes is limited by unfavorable weather conditions. Especially is this true when the planting is done as late as June 15, because not enough of favorable growing season remains to allow for a good production of roots. In these instances each plant makes only a small weight of potatoes, regardless of the spacing, and the more plants one has the higher will be his yield.

One of the best practices to insure good yields, therefore, is to set plenty of plants. They should be set so that they will live and grow off fast, and each one will produce a good crop of roots.

Sweetpotato Plant Spacing

By W. S. Anderson, E. A. Currey,
E. B. Ferris, and J. C. Robert

The influence of the planting distances of sweetpotatoes on the yield and grade of the crop is of great economic importance. The grower wants to obtain a high total yield in some instances, but in most instances the highest possible yield of U. S. No. 1 or market size sweetpotatoes is the objective. In general, the No. 2 grade may also be considered as marketable, although bringing a lower price than the No. 1. The grower also wishes to obtain this highest yield of marketable sweetpotatoes at the lowest unit cost.

The propagation of sweetpotatoes requires painstaking care, much planning, and detailed attention from the day the old crop is harvested until the new crop is set in the field. At best the setting out of a field of sweetpotatoes is a tedious, laborious, and expensive task. These facts cause a tendency for the growers to set fewer plants to the space allotted for growing sweetpotatoes, that is, to practice wide spacing of plants. Moreover, any reduction in the plant requirements means smaller needed supplies of seed stock, requiring less storage space and less propagation bed space.

Determining the most profitable spacing of sweetpotatoes must therefore involve several factors. With starch sweetpotatoes, such as the Triumph, where the unit price is the same regardless of grade, only the total yield and cost are important; but even in this instance, close spacing requires more plants and more work in setting, and the calculation should show whether such extra expense is justified in the profit column.

Table-stock sweetpotatoes, of which the Porto Rico is perhaps the leading variety in Mississippi, are marketed almost without exception on grade. Number 1 grade sweetpotatoes sell at a much higher price per pound or per bushel than number 2 grade, while Jumbos and Culls are unmarketable or nearly so. The objective, therefore, is to produce the maximum quantity of the marketable grades and the minimum quantity of the unmarketable grades. In view of the importance thus attached to the grade of the crop produced, determination of the most profitable rate of spacing becomes more complicated than in the case of starch potatoes marketed from the field ungraded and without storage or package. The yield of marketable grades, rather than total yield, is of chief importance for comparison with costs. Costs incurred after the potatoes are harvested—grading, curing, storage, packages—must be considered in addition to cost of plants, land preparation, setting, culture, harvesting, and delivery to market. Only when all these factors are considered can profit—the final measure of any farm practice—be determined in sweetpotato spacing experiments. Only such complete information can accurately guide farmers in their planting operations.

SWEETPOTATO SPACING STUDIES IN THE SOUTH

Considerable experimental work has been done in the various southeastern states with spacing sweetpotatoes. The results of those experiments are briefly reviewed in the following paragraphs. The recommendations on plant spacing for these states are also summarized.

Influence of Spacing on Grade

Beattie, Boswell and Hall (2), from experiments conducted over a period of 3 years in South Carolina, concluded that spacings of 6, 9, 12, and 15 inches between plants of the Porto Rico sweetpotato in 4-foot rows showed that the closer spacings decreased the proportion and yield of jumbo size roots and that the 6-inch spacings increased the proportion and yield of the Number 2 size over the 9-, 12-, and 15-inch spacings. They found that these spacings did not appreciably affect the proportion or yield of Number 1 or the total yield. Because of this lack of increase in the marketable grades and the additional requirements in plants and labor for closer spacings, they recommended 12 or 15 inches for spacing in the row for South Carolina conditions.

Woodward (10) conducted tests for 6 years on sandy soils at Tifton, Georgia, with the Porto Rico variety spaced by 4-inch differences from 4 to 28 inches in rows 3½ feet apart. A uniform fertilizer treatment was given to all spacings. He concluded that the yield of Number 1 potatoes varied very little, although the total yields were considerably higher from the closer spacings, the greater yield resulting from a greater amount of Number 2 grade and strings which were obtained from the closer spacings.

Uniform Fertilizer Application

In a supplementary test Woodward applied fertilizer so that, regardless of the spacing, each plant received the same amount of fertilizer, that is; when 800 lbs. were applied to a 16-inch spacing, 1600 lbs. would be applied to 8-inch spacing. In a 4-year average the data he obtained show that the yield of Number 1 and total yield gradually increased as the spacing decreased from 28 to 4 inches, with the yield being about 3 times as great on the 4- as the 28-inch spacing. He concluded, however, that the most conservative spacing of plants was 12 inches, taking into consideration the cost of plants and fertilizer and the returns from the Number 1 sweetpotatoes.

Miller and Kimbrough (6) found in experiments with 9-, 12-, 15-, 18-, and 21-inch spacings at Louisiana State University that a greater yield of over-size roots was obtained from wider spacings on the more fertile soils. They obtained higher total yields and higher Number 1 yields from the 12-inch spacing. The 9-, 12-, and 15-inch spacings produced about the same yield of Number 2, which exceeded slightly the yield of Number 2 from the wider spacings. The soil used in their experiments was very fertile, producing nearly 400 bushels of Number 1 grade sweetpotatoes. Apparently, under the conditions of those experiments, the effect of wider spacing was to make Number 1 grade out of some of the Number 2's and to make jumbos out of some of the Number 1's, as well as to reduce the total yield and No. 1 yield. They recommend a 12-inch spacing for June 1 planting on Louisiana soils.

Zimmerley (11), working with the Porto Rico variety planted on a Sassafras loam soil at Norfolk, Virginia, compared 10-, 14-, 18- and 22-inch spacings and found that in general the closest spacings gave the highest yields of marketable and total grades. The yields from the 10-inch were not significantly greater than those from the 14-inch, but the yields from both of these were greater than from the wider spacings.

The Alabama station (9) has conducted tests of plant spacing and fertilizer rate combinations in the southern part of that state for several years. For the early harvested (August) crop of the Triumph variety they recommend an 18-inch planting distance with 800 pounds to the acre of a 4-10-7 fertilizer mixture for best results.

The North Carolina station (8) has concluded that for that state the grower of Porto Rico sweetpotatoes for market should space the plants 12 inches in rows 3½ feet apart. The recommendation is the result of data obtained in a 2-year test of 8-, 10-, 12-, 15-, and 18-inch spacings and a 4-year test of 12-, 18-, and 24-inch spacings.

South Carolina (5) growers are given the recommendation to plant Porto Rico 10 or 12 inches apart in rows 3½ to 4 feet apart for best yields of Number 1 potatoes.

The Arkansas station (3) recommends that the earlier the planting the closer must be the spacing to avoid jumbo grade production, and advises a 12-inch spacing for early planting with not more than 15 inches for medium season planting.

Spacing Work With Nancy Halls

At the West Tennessee Experiment Station (4) tests for the period of 1926-1931 with Nancy Hall planted at 6-, 12-, 18-, and 24-inch spacings in 3-foot rows at approximately 3-week intervals from the first week of May to the first week of July, showed that 6 inches was not too close on fertile soil. At all the dates of setting, the 6-inch and 12-inch spacings made decidedly greater total yields than the wider spacings, but the 18-inch was not much better than the 24-inch. In 1931 the crop was graded into "eating" potatoes and "seed" potatoes, and the greatest yield of the "eating" grade was found on the 18-inch and 24-inch spaced plots, at all planting dates.

Published Results in Mississippi

Realizing the importance of spacing sweetpotato plants in the production of this crop, the Mississippi Station has conducted tests of different spacings at several locations in the state for many years. The results of the earlier experiments have been published but they are reviewed briefly below.

At the Holly Springs Branch Station (1) 7-, 14-, and 21-inch spacings were compared for the Nancy Hall variety in 1923 and 1925 and for the Porto Rico in 1926. The results show that from 20 to 30 bushels were added to the total yield by each 7-inch reduction in space between hills in the row, in all years and with both varieties. It was concluded, that, taking into consideration the extra cost of plants and setting, the fourteen-inch spacing gave the most economical yield.

From 1925 to 1929 Price (7) planted Nancy Hall sweetpotatoes at State College at 10-, 15-, 20-, 25-, 30-, and 35-inch distances in the row and graded the yield into "marketable" and "unmarketable" roots. His results show that the closer the spacing up to 20 inches the higher the yield of marketable potatoes. The 10-inch spacing made a 5-year average of 40 bushels more than did the 15-inch spacing and 48 bushels more than did the 20-inch spacing. The wider distances about equaled each other in yield. Price weighed representative potatoes from the various spacings and found that there was an average increase in the weight of the potatoes of nearly one-tenth of a pound for each increase of 5 inches in planting distance.

MISSISSIPPI TESTS OF A TABLE VARIETY

During 1938, 1939, and 1940 experiments have been conducted at several Branch Experiment Stations in Mississippi with different plant spacings and different rates of fertilizer. The experiments fall into two general divisions: tests of a table variety, in which results are interpreted in terms of marketable grades; and tests of a starch or feed variety, in which results are interpreted in terms of total yields.

Porto Rico Variety Used

The Porto Rico, a table variety of good quality and high yield now widely plant-

TABLE 1.—SCHEDULE OF COSTS TO THE ACRE OF PLANTING AND CULTIVATING SWEETPOTATOES USING DIFFERENT RATES OF 4-8-4 AND DIFFERENT PLANT SPACINGS

Rate of 4-8-4, lbs. to the acre	Plant Spacing in row, inches	Fertilizer	Plants	Plowing, and preparing	Planting, fertilizer application	Two hoeings, three cutivations	Total fixed costs
500	9	$ 4.81	$16.60	$4.12	$6.47	$5.50	$37.50
500	12	4.81	12.45	4.12	4.91	5.50	31.79
500	18	4.81	8.30	4.12	3.36	5.50	26.09
1000	9	9.62	16.60	4.12	6.72	5.50	42.56
1000	12	9.62	12.45	4.12	5.16	5.50	36.85
1000	18	9.62	8.30	4.12	3.61	5.50	31.15
1500	9	14.43	16.60	4.12	6.97	5.50	47.62
1500	12	14.43	12.45	4.12	5.41	5.50	41.91
1500	18	14.43	8.30	4.12	3.86	5.50	36.21

ed in Mississippi, has been used in the first phase of the work. Throughout the experiments, planting and harvesting have been done at the time which represents the local practice for the particular area of the state. A 4-8-4 fertilizer mixture was applied in these experiments at the Holly Springs, Natchez, and Poplarville Branch Stations, at the rates of 500, 1000, and 1500 pounds to the acre; and on each of these fertilizer rates, plants were spaced 9, 12, and 18 inches apart in 42-inch rows. At the Delta Station previous experiments had shown that nitrogen fertilizer alone was the best application for sweetpotatoes, so that, in these tests ammonium sulfate alone was applied at the rates of 100 and 200 pounds to the acre with plants being spaced 9, 12, and 18 inches apart in 42-inch rows on each rate of fertilizer and on plots which received no fertilizer.

In these experiments all of the fertilizer for the various rates was applied several days before planting, and it was thoroughly mixed with the soil within the ridge as the latter was being prepared. The ridge method of culture was followed throughout. Harvesting was accomplished by plowing out the rows, assorting the potatoes into U. S. grades according to size, and weighing them immediately in the field.

Net Profits Interpretation

Since it is largely the net profit that growers are interested in, an effort has been made to present the data from these tests in such a way as to reveal the profits that can reasonably be expected from the various treatments. The costs involved in connection with different plant spacing and fertilizer rate practices vary greatly, and are detailed in tables which follow.

The value of the number 1 plus number 2 grades of Porto Ricos produced in these experiments has been considered as 80 cents for 60 pounds of freshly harvested potatoes. This was the average price of sweetpotatoes in Mississippi for the 10-year period of 1929 to 1938, according to U. S. census reports. In general, 60 pounds of freshly harvested sweetpotatoes will be required for marketing a standard crate from storage. The costs deducted from this crop value in computing the net profits are shown in table 1 for all of the experiments conducted at hill stations, and in table 5 for those at the Delta branch station.

Schedule of Production Costs

The fertilizer cost assumes home mixing of nitrate of soda, superphosphate, and muriate of potash, and its application with a machine simultaneously with plant transplanting. This is thought to be the cheapest method of fertilizer ap-

TABLE 2.—INFLUENCE OF PLANT SPACING ON TOTAL YIELD OF PORTO RICO SWEETPOTATOES — HOLLY SPRINGS

Pounds 4-8-4 to the acre,	Plant spacing in row, inches	Total yield, bu. (60 lbs.) to the acre
500	9	200
500	12	187
500	18	200
1000	9	230
1000	12	231
1000	18	218
1500	9	212
1500	12	214
1500	18	191

plication. Plants have been charged at one dollar a thousand, and planted with tractor-drawn standard transplanting machines. It is doubtful whether the estimate of transplanting costs for close spacing can be applied to mule drawn machines because teams usually do not travel slow enough for close planting. The cost of transplanting by machine may not vary greatly from the cost of transplanting by hand where the planted area is relatively small. The cost estimates for labor and power of plowing, preparing, hoeing and cultivating are based on standard good farm practice in the southeastern states.

In addition to the costs of producing the crop, scheduled in tables 1 and 5, are other costs. The cost of harvesting the crop has been figured at 4½ cents a bushel, and includes the plowing out, picking up by hand, roughly assorting the grades, and placing into some convenient style of field crates. A cost of 25 cents a bushel has been included to cover curing, storing, final grading, packing, crates, and hauling to market.

Experiments at Holly Springs

The soil used for these experiments at the Holly Springs branch station is classified as Grenada silt loam, one of the Brown loam soils, regarded as well adapted to sweetpotatoes. Only one year's results are available from recent work at that Station, and the data are presented in table 2. These data show that the greatest total yield was obtained from moderately close spacing in combination with moderately high fertilization. The potatoes were not graded and for that reason no attempt has been made to estimate the net profits from the various treatments.

With the application of 500 pounds of 4-8-4 fertilizer, the 9-inch and 18-inch spacings each yielded 200 bushels per acre. The highest yield in the test was from the 12-inch spacing and 1000 pounds of fertilizer, 231 bushels per acre. At the 1000-pound rate of fertilization, the 9-inch spacing yielded 230 bushels, and the 18-inch spacing yielded 218 bushels. Increasing the fertilizer to 1500 pounds per acre resulted in yields from all spacings lower than from the 1000 rate, and only slightly higher than from the 500-pound rate of fertilization.

Experiments at Natchez

The soil on which these experiments were planted at the Natchez station is also Grenada silt loam, and the plots in 1938 and 1939 were on a fertile area. Weather conditions were favorable for sweetpotato production, and high yields were obtained.*

The data in table 3 show that the total yield was increased as the spacing de-

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*Planting, cultivating, and harvesting of the plots were under the supervision of S. J. Greer and W. T. Mallory in 1938, and S. P. Crockett and W. T. Mallory in 1939.

TABLE 3.—INFLUENCE OF PLANT SPACING ON PROFIT FROM PORTO RICO SWEETPOTATOES — NATCHEZ

Rate of 4-8-4, lbs. to the acre	Plant spacing in row, inches	1938			1939		
		60 lb. bu. to the acre		Net profit, dollars to the acre	60 lb. bu. to the acre		Net profit dollars to the acre
		Total	No. 1 & 2		Total	No. 1 & 2	
500	9	418	329	129.47	328	300	114.75
500	12	365	279	109.80	371	293	116.91
500	18	357	253	102.31	270	235	93.17
1000	9	361	269	93.96	377	293	106.14
1000	12	390	294	112.35	352	288	109.31
1000	18	419	322	132.27	337	300	121.10
1500	9	424	335	122.39	403	223	65.55
1500	12	331	254	87.00	401	303	111.86
1500	18	396	291	111.47	373	304	118.07

creased for each rate of fertilizer, with one exception in each of the years covered by the tests. The higher rates of fertilizer gave slightly higher total yields. In the yield of No. 1 plus No. 2 grades there was little difference between the higher and lower fertilizer rates, but at the 500-pound rate of fertilization, close spacing seemed to make an increased amount of marketable grades. The data show that the greatest net profit usually came from those treatments giving the highest yield of marketable (1 and 2) grades. The low rate of fertilizer and wide spacing gave, in general, the lowest profit.

The highest acre profit in 1938 was $132.27, and in 1939 $121.10. Both came from plots spaced 18 inches and fertilized with 1000 pounds of fertilizer. These profits did not differ greatly from profits in other treatments. It was only $2.80 more than the profit from 9-inch spacing and 500 pounds of fertilizer in 1938, and it was only $4.19 more than the profit from 12-inch spacing and 500 pounds of fertliizer in 1939.

Experiments at Poplarville

The soil on which these experiments were planted at the South Mississippi station at Poplarville is Ruston fine sandy loam, one of the Long Leaf Pine soils of low fertility, but usually considered to be adapted to the growing of good quality sweetpotatoes. The yields obtained there in 1939 and 1940 were very low, explainable at least in part by

TABLE 4.—INFLUENCE OF PLANT SPACING ON PROFIT FROM PORTO RICO SWEETPOTATOES — POPLARVILLE

Rate of 4-8-4, lbs. to the acre	Plant Spacing in row, inches	1939			1940		
		60 lb. bu. to the acre		Net profit, dollars to the acre	60 lb. bu. to the acre		Net profit dollars to the acre
		Total	No. 1 & 2		Total	No. 1 & 2	
500	9	104	53	—10.60	138	112	19.34
500	12	88	46	— 8.45	97	85	11.35
500	18	98	46	— 2.75	80	57	2.84
1000	9	133	61	—11.60	154	122	19.35
1000	12	152	66	— 3.36	122	89	8.32
1000	18	117	44	— 8.82	132	93	16.05
1500	9	190	90	— 1.95	126	90	— 1.95
1500	12	162	74	— 4.36	177	115	16.45
1500	18	150	68	— 1.70	129	87	7.94

Minus symbol (—) indicates loss.

TABLE 5.—SCHEDULE OF COSTS TO THE ACRE OF PLANTING AND CULTIVATING SWEETPOTATOES USING DIFFERENT RATES OF AMMONIUM SULPHATE AND DIFFERENT PLANT SPACINGS

Pounds Ammonium Sulphate to the acre	Plant Spacing in row, inches	Fertilizer	Plants	Plowing and preparing	Planting, fertilizer application	Two hoeings, three cultivations	Total fixed costs
100	9	$1.60	$16.60	$4.12	$6.47	$5.50	$34.29
100	12	1.60	12.45	4.12	4.91	5.50	28.58
100	18	1.60	8.30	4.12	3.36	5.50	22.88
200	9	3.20	16.60	4.12	6.72	5.50	36.14
200	12	3.20	12.45	4.12	5.16	5.50	30.43
200	18	3.20	8.30	4.12	3.61	5.50	24.73
None	9	0	16.60	4.12	6.22	5.50	32.44
None	12	0	12.45	4.12	4.66	5.50	26.71
None	18	0	8.30	4.12	3.11	5.50	21.03

the fact that in neither of these years was the rainfall favorable for sweetpotatoes.

The results in table 4 show, in the first place, that the low yields obtained prevented any net profit in 1939 and in one case in 1940. They show also that higher total and marketable yields were obtained from the closer spacings at all rates of fertilizer in 1939, and at the 500- and 1000-pound rates in 1940. In 1940 net profits from the 12-inch spacing exceeded profits from the 9- and 18-inch spacings at the 1500-pound fertilizer rate. The highest profits in 1940 and the lowest losses in 1939 came from those treatments which gave the highest yields of No. 1 plus No. 2 grades.

From the standpoint of profit, by a narrow margin, the best treatment in 1940 was the 9-inch spacing in conjunction with 1000 pounds fertilizer. This treatment yielded a net profit of $19.35. However, the 9-inch spacing with 500 pounds of fertilizer yielded a profit smaller by only 1 cent per acre. The 12-inch spacing was most profitable at the 1500-pound rate of fertilizer application, but was $2.90 less than from 9-inch spacing with 1000 pounds of fertilizer, and $2.89 less than the profit from 9-inch spacing with 500 pounds of fertilizer.

These data indicate that a total yield of more than 150 bushels per acre must be harvested before a profit can be made from the production of sweetpotatoes.

Experiments at Stoneville

The soil at the Delta station on which these experiments were planted is a very fertile soil classified as Sarpie loam and is well adapted to the growing of sweetpotatoes. High yields of sweetpotatoes are frequently made on this soil, fertilized with nitrogen only, or unfertilized. In the spacing experiment conducted at Stoneville in 1939 and 1940 only ammonium sulphate was applied to the three plant spacings, and in one series of similar plant spacings no fertilizer was applied. In terms of actual nitrogen, the 100-pound treatment contained 20 pounds of nitrogen and the 200-pound treatment contained 40 pounds of nitrogen.

The cost schedule used in calculating the results to the net profit basis are shown in table 5. The cost of the nitrogen in ammonium sulphate has been figured at 8 cents a pound for the actual nitrogen.

The results at the Delta station, presented in table 6 show that for 1939, not only the greatest total yield, but also the largest No. 1 plus No. 2 yield, and the highest net profit, resulted from 9-inch spacing without fertilizer. At the various fertilizer rates, the closer the plants were spaced, the greater was the

TABLE 6.—INFLUENCE OF PLANT SPACING ON PROFIT FROM PORTO RICO SWEETPOTATOES — STONEVILLE

		1939			1940		
Rate of ammonium sulphate, lbs. to the acre	Plant spacing in row, inches	60 lb. bu. to the acre		Net profit, dollars to the acre	60 lb. bu. to the acre		Net profit, dollars to the acre
		Total	No. 1 & 2		Total	No. 1 & 2	
100	9	326	256	95.38	216	183	58.33
100	12	307	220	83.82	212	177	62.00
100	18	262	178	67.20	198	144	49.91
200	9	254	182	56.23	249	205	67.90
200	12	252	179	61.41	242	195	69.53
200	18	251	153	52.92	239	173	63.07
None	9	363	270	104.58	198	161	49.27
None	12	321	255	103.68	191	155	52.93
None	18	302	204	82.50	147	117	38.35

total and the marketable yield. In 1940 the total and marketable yields were considerably lower than in 1939, due probably to the influence of weather conditions. With these lower yields in 1940, the greatest net profit resulted from 200 pounds ammonium sulphate with 12-inch spacing. Results from this treatment were practically the same in net profit, however, as the 200-pound and 9-inch treatment.

The 1939 top profit of $104.58 secured from 9-inch spacing and no fertilizer, only slightly exceeded the profit of $103.68 from 12-inch spacing and no fertilizer. Of the fertilized plots in 1939, the 100-pound fertilizer treatment was less profitable than no fertilizer, but more profitable than the 200-pound treatment. The reverse was true in 1940, when the unfertilized plots as a group were least profitable, the 100-pound treatment next, and the 200-pound treatment was most profitable. Highest profit in 1940, $69.53, was from 12-inch spacing with 200 pounds ammonium sulphate, followed in order by $67.90 profit from 9-inch spacing with 200-pounds fertilizer, $63.00 from 18-inch spacing with 200 pounds fertilizer, and $62.00 profit from 12-inch spacing and 100 pounds ammonium sulphate.

HIGH YIELDS MARKET GRADES FOR PORTO RICO PROFIT

Importance of Grades

Because of the lack of sale value and the low use value of the jumbo and cull (strings) grades, it is important for the grower to know how many bushels of these grades it is necessary for him to harvest and handle under any field treatment in order to get a given amount of marketable product. Data are presented in table 7 which show the distribution of these grades from the plots in 1939 at the Natchez, Poplarville and Delta stations. In 1940, the No. 1 and No. 2 grades were separated at the Delta and Poplarville stations, and the data are presented in table 8.

A drought during the growing period at Natchez in 1939 prevented the production of jumbo size roots, but there was a greater production of cull size there than was obtained at any other station or in any other year. The treatments had little effect upon the amount of cull size roots. At the Poplarville and Delta stations, more bushels of jumbo size were produced as the rate of fertilizer rate was increased, on all spacings. At neither station did the treatments have any appreciable effect upon the yield of culls. At the Delta station that year

TABLE 7.—DISTRIBUTION OF GRADES OF PORTO RICO SWEET POTATOES IN 1939 FROM THREE PLANT SPACINGS AND VARIOUS FERTILIZER TREATMENTS

Rate of 4-8-4 lbs. to the acre	Plant spacing in row, inches	Bushels (60 lbs.) to the acre of grades shown		
		Jumbos	Nos. 1 & 2	Culls
		Natchez Branch Station, Natchez		
500	9	0	271	57
500	12	0	308	63
500	18	0	217	53
1000	9	0	317	60
1000	12	0	283	69
1000	18	0	278	59
1500	9	0	336	67
1500	12	0	352	49
1500	18	0	317	56
		South Mississippi Branch Station, Poplarville		
500	9	21	53	30
500	12	21	46	21
500	18	26	46	26
1000	9	40	61	32
1000	12	50	66	36
1000	18	48	44	25
1500	9	67	90	23
1500	12	62	74	26
1500	18	52	68	30
Lbs. ammonium sulphate to the acre		Delta Branch Station, Stoneville		
100	9	38	256	20
100	12	66	220	20
100	18	64	178	20
200	9	46	182	26
200	12	52	179	21
200	18	77	153	21
None	9	62	270	31
None	12	41	255	25
None	18	77	204	21

there was an increased yield of jumbo size as the spacing increased.

In table 8 it is shown that at Stoneville the lower yields in 1940 resulted in a very low yield of the jumbo size, as well as a greatly reduced yield of the No. 1 size. More jumbo size roots also were produced with the higher rate of fertilizer and wider spacing. The highest yield of No. 1 grade, which commands the highest obtainable price when separated from No. 2, was obtained under 1940 conditions at the Delta from 12-inch spacing and 200 pounds of sulphate of ammonia. (table 6) On the plots not fertilized there were as high yields of No. 2 as of No. 1 grade. The No. 2 grade was about the same for all treatments, the variation in yields among plots being in the jumbo and No. 1 sizes.

At Poplarville in 1940 the various fertilizer treatments and plant spacings were practically alike in yield of No. 2 and cull grades. The 1000- and 1500-pound fertilizer rates made significantly more jumbos than the 500-pound rate. Also, the wider the spacing on these rates the more jumbos were produced.

TABLE 8.—DISTRIBUTION OF GRADES OF PORTO RICO SWEETPOTATOES IN 1940 FROM THREE PLANT SPACINGS AND VARIOUS FERTILIZER TREATMENTS

Lbs. Ammonium sulphate to acre	Plant spacing in row, inches	Bushels (60 lbs.) to the acre of U. S. grades			
		Jumbo	No. 1	No. 2	Culls
		Delta Branch Station, Stoneville			
100	9	1	110	73	32
100	12	9	108	69	26
100	18	35	75	69	19
200	9	19	127	78	24
200	12	22	108	87	26
200	18	42	97	76	24
None	9	9	76	85	28
None	12	11	69	86	25
None	18	8	60	57	22
Lbs. to the acre, 4-8-4		South Mississippi Branch Station, Poplarville			
500	9	9	89	23	16
500	12	0	56	22	19
500	18	0	41	16	23
1000	9	10	97	25	22
1000	12	19	56	23	24
1000	18	26	68	24	18
1500	9	12	53	28	24
1500	12	36	104	19	18
1500	18	20	62	24	21

Except at the 1500-pound rate of fertilization, the 9-inch spacing made very much greater yields of No. 1 size. The most profitable treatment (table 4) was 9-inch spacing and 1000 pounds fertilizer.

STARCH POTATO TESTS IN THE LAUREL AREA

The production of sweetpotatoes for manufacture into starch is a new but important and increasing agricultural industry in Mississippi.

The nation's first sweetpotato starch factory was established at Laurel in 1934 by the Federal Emergency Relief Administration, to supply work to unemployed and an additional cash crop to low-income farmers. It has since been operated as a grower-owned cooperative, sponsored by the Farm Security Administration and the Agricultural Adjustment Administration. It received 265,000 bushels of sweetpotatoes in 1939, from which was manufactured 2,700,000 pounds of starch. Production was somewhat less in 1940, due to unfavorable weather conditions which greatly reduced yields, but the planted acreage is greatly increased in 1941. Considerable interest is being manifested not only in the use of sweetpotatoes for starch manufacture in additional areas, but also in processes of dehydration and use of the dehydrated product as a carbohydrate equivalent to corn in livestock feeding.

Sweetpotato of High Potential Value

The sweetpotato undoubtedly ranks high among the potentially valuable Southern farm crops. Yields secured under average good management in the Laurel area almost double the average for the state as a whole; and yields of 150 bushels to 200 bushels per acre means, roughly, the equivalent of a ton of starch per acre, or dehydrated sweetpotato meal equivalent to about 50 bushels of corn per acre. The sweetpotato crop is laborious, and therefore expensive, to produce and harvest, however; and high yields and minimum-for-efficiency costs are necessary for growers to profit.

In view of the present and potential importance of sweetpotatoes for industrial usage, the Mississippi Agricultural Experiment Station in cooperation with the Bureaus of Plant Industry and of Agricultural Chemistry and Engineering USDA, has engaged in a rather complete field of research since the beginning of the industry in the Laurel area. These experiments have been concerned with varieties, plant production, fertilization, plant setting and spacing, culture, harvesting, storage, and product and by-product processes and utilization,

This report presents and summarizes data secured with reference to the spacing of plants in the row, together with certain general information on fertilization, plant setting, and production costs which are necessary for the factual interpretation of results.

Triumph Variety Used

The Triumph has long been grown in the South, is well adapted to Southern conditions, and is generally known as one of the highest yielding sweetpotato varieties. Southern tastes show decided preference to the moist, yellow varieties such as Porto Rico and Nancy Hall; and since the Triumph is a dry, white variety, it is not in favor as table stock in the South. The Triumph is grown in considerable quantities for table use, however, particularly in southern portions of Alabama, where a very large acreage is planted for early shipment to Northern markets.

The Triumph, under Mississippi conditions, combines high yield with high starch content; hence it has long been used on Southern farms as stock feed; and with the establishment of the starch factory at Laurel, the Triumph was adopted as the standard variety for starch-making purposes.

The production of Triumph sweetpotatoes for starch, or for dehydration, or for feeding to livestock, is essentially similar to the production of table varieties such as the Porto Rico. There are certain differences, however.

Net Profits Interpretation

High total yield at minimum unit cost is the objective in starch sweetpotato production. Market grades, though extremely important in the production of table varieties, are of little or no importance with starch sweetpotatoes, which are sold "field run" at a given price per bushel or per ton; that is, the price is the same for all the sweetpotatoes whether large or small, or whether smooth or irregular in shape. In fact, a large production of jumbos seem desirable, for a given weight of large potatoes is easier, hence less expensive, to harvest.

Earlier planting of the Triumph than of the table varieties seems desirable, since earlier planting usually means higher total yield.

Machine transplanting is apparently a necessity in starch sweetpotato production, because the acreage is relatively large on farms where grown, and because planting time is the labor peak in sweetpotato production. Mechanical transplanting not only enables a given number of workers to set a larger acreage in a day, but they also supply a small quantity of water to each plant set and so make the planting of the crop less dependent on local moisture conditions. These advantages apply also to sweetpotatoes to be used for table stock, but possibly to a slightly less urgent degree.

Transplanters have not been used for sweetpotatoes in the South to any considerable extent until recently, and are rapidly being improved and adapted to

TABLE 9.—SCHEDULE OF COSTS TO THE ACRE OF PLANTING AND CULTIVATING SWEETPOTATOES AT VARIOUS SPACINGS IN THE ROW AND WITH 1000 LBS. TO THE ACRE OF 6-8-6 FERTILIZER

Spacing in row, inches	Fertilizer and application	Plants	Trans-planting	Preparation, two hoeings, three cultivations	Total fixed costs
6	$13.10	$24.90	$9.33	$9.62	$56.95
9	13.10	16.60	6.22	9.62	45.54
12	13.10	12.45	4.66	9.62	39.83
15	13.10	9.96	3.73	9.62	36.41
18	13.10	8.30	3.11	9.62	34.13
21	13.10	7.11	2.66	9.62	32.49
24	13.10	6.23	2.33	9.62	31.28

the crop. On this account, not enough data have been collected for an exact comparison of costs of transplanting by machine with cost of transplanting by hand. It appears at present that transplanting by machine is somewhat less expensive per acre than by hand, but the difference is not great. It is believed that as transplanting machines are better adapted and their operation is better understood, the expense of transplanting an acre by machine will be much less than by hand; but in the meanwhile the transplanting cost data shown in tables 1, 5, 9, and 12 may be of some practical use to the grower for comparison with his own costs, whether by machine or by hand.

In cooperation with the member-growers of the cooperative sweetpotato starch factory at Laurel, the Mississippi Station has carried on various spacing experiments during the years 1937, 1938, 1939, and 1940, using the Triumph variety. The experiments have been conducted on different fields and on different farms from year to year. This has served the purpose of quickly acquiring desired information on several principal types and grades of soil, and has enabled local growers to see and immediately profit by results secured. On the other hand, the fact that each of the tests was not located on one plot throughout the experimental period, prevents the averaging of results. Sprouts were used throughout those experiments and practically perfect stands were obtained on each plot.

In computing the profit from tested treatments, the value of the crop was assumed to be 30 cents a bushel, which is the amount paid for "field run" potatoes at the starch factory. The cost schedule (table 9) includes cost of producing the crop; to this is added an estimated cost for harvesting and hauling to the factory, at 8¼ cents per bushel.

Two Series of Experiments

The spacing experiments were in two series: one series in which plants were spaced different distances in the row, but in which all plots received uniform applications at the rate of 1000 pounds of 6-8-6 fertilizer per acre; in the other series, three plant spacings and three rates of 4-8-4 fertilizer were employed.

Spacing Starch Sweetpotatoes With Uniform Application Of Fertilizer

In the uniformily fertilized spacing test, plants were spaced at row intervals of 6, 9, 12, 15, and 18 inches, in 1937 and 1939. In 1940, plants were spaced at these intervals and also at 21- and 24-inch intervals. Rows were 42 inches wide. All plots received 1000 pounds to the acre of 6-8-6 fertilizer mixture, applied before setting the plants.

TABLE 10.—INFLUENCE OF PLANT SPACING ON PROFIT FROM TRIUMPH SWEETPOTATOES, 1000 POUNDS 6-8-6 TO THE ACRE — LAUREL

Plant spacing in row, inches	1937		1939		1940	
	60 lb. bu. to the acre	Net profit, dollars to the acre	60 lb. bu. to the acre	Net profit, dollars to the acre	60 lb. bu. to the acre	Net profit, dollars to the acre
6	294	6.99	352	19.61	342	17.61
9	188	—4.65	341	28.63	313	22.29
12	166	—3.75	307	26.94	329	30.88
15	171	0.78	283	25.14	303	29.49
18	167	2.19	275	25.68	285	26.79
21*					292	31.09
24*					282	30.09

*These spacings planted in 1940 only.

The tests in 1937 were located on moderately poor Cahaba sandy loam soil, a terrace or "second bottom" soil common to the coastal plains area. They were planted on May 22 and harvested October 8. Due largely to unfavorable weather conditions rather low yields were secured, with the 6-inch spacing yielding 294 bushels, the 12-inch spacing 166 bushels, and the 18-inch spacing yielding 167 bushels to the acre. Details shown in table 10 reveal that the 12-, 15-, and 18-inch spacings resulted in about the same total yield, while the 9-inch and 6-inch spacings gave much greater yields. The 6-inch was the only spacing that gave any worthwhile profit, and the 9- and 12-inch spacings actually gave losses.

Somewhat better yields were secured in 1939, when the test was located on moderately fertile Cahaba sandy loam soil, planted April 26 and harvested October 7. During this year closer spacings gave higher yields, and there was a gradual step-down in yields as the space between the plants was increased. The highest net profit in 1939 was secured from the 9-inch spacing. However, this profit was only $1.69 more than that secured from the 12-inch spacing, and only $2.95 more than that secured from the 18-inch spacing.

The 1940 test was located on fertile Cahaba sandy loam soil, planted June 14 and harvested November 7. In the Laurel area as a whole, weather conditions were quite unfavorable to sweetpotato production in 1940. On the farm on which this test was located rains fell at opportune times late in the season, and as shown in table 10, a good crop was harvested. As in the test of 1939 there was less difference in yield between the close and wide spacings, though the general downward trend of yield was continued as spacing was increased from 6 inches up to 18 inches. 1940 was the only year in which wider than 18-inch spacings were tested, and during this year there was but little difference in total yield between 18-inch, 21-inch, and 24-inch spacings. The highest net profit secured in 1940 was $31.09, from the 21-inch spacing, followed in order by a profit of $30.88, from the 12-inch spacing, and a profit of $30.09, from the 24-inch spacing.

During the three years in which this series of experiments was conducted, the peak in profits in 1937 was $6.99 from 6-inch spacing, in 1939 $28.63 from the 9-inch spacing and $30.88 from the 12-inch spacing in 1940, excluding the 21- and 24-inch spacings because they were tried only one year. In general, it may be observed that the highest yields were obtained from close spacing; but not every decrease in spacing gave a significant increase in yield, and in only one year of the three did the highest yield result in the highest net profit.

TABLE 11.—DISTRIBUTION OF GRADES OF TRIUMPH SWEETPOTATOES, FROM 1000 LBS. 6-8-6 FERTILIZER AND VARIOUS PLANT SPACINGS — LAUREL

Plant spacing in row, inches	Bushels (60 lbs.) to the acre of U. S. grades				
	Jumbo	No. 1	No. 2	Culls	Total
			1937		
6	3	149	72	70	294
9	7	86	45	50	188
12	6	92	36	32	166
15	21	98	26	26	171
18	6	87	37	37	167
			1939		
6	0	171	125	56	352
9	3	181	108	49	341
12	3	167	108	29	307
15	4	156	88	35	283
18	5	162	70	38	275
			1940		
6	0	216	101	25	342
9	0	224	55	24	313
12	2	251	61	15	329
15	13	219	57	14	303
18	7	230	37	11	285
21	15	237	34	6	292
24	13	230	27	12	282

The data in table 11 shows that in these trials the years making the higher total yields on the wider spacings also made the higher yields of over-size or jumbo potatoes. Small yields of jumbos were usually associated with a high production of No. 2 and cull sizes. When high total yields were made by the 6-, 9-, or 12-inch spacings, there was usually a high yield of No. 1 and No. 2 sizes. Grade or size may seem unimportant in starch growing; actually, it is easier and therefore less expensive to harvest relatively large sweetpotatoes than very small ones. Especially is this true if mechanical harvesting is done, because the larger, individually heavier, roots are more easily separated from the strings, vines and soil.

Spacing Starch Sweetpotatoes With Varying Rates Of Fertilizer

In the second series of spacing tests, plants were spaced 9, 12, and 18 inches apart in the drill and fertilizer was used on each of these spacings at the rate of 500, 1000, and 1500 pounds to the acre of a 6-8-4 fertilizer mixture. The schedule of costs at the different rates of fertilizer and different plant spacings is shown in table 12.

In determining profit, the appropriate amount from this schedule of costs, plus a charge of 8¼ cents a bushel for harvesting and handling, was deducted from the values of the total yield at 30 cents a bushel. The results from these fertilizer rate plant-spacing combinations are shown in tables 13 and 14.

In 1938 the tests were conducted on a moderately fertile Orangeburg sandy soil, an upland or hill soil common to the coastal plains area, planted May 5 and harvested October 26.

These data show that with one exception, for each fertilizer rate the greater total yields came from the closer spacing of plants. From the viewpoint of profit, at the 500-pound rate of fertilization the highest net profit came from 9-inch

TABLE 12.—SCHEDULE OF COSTS TO THE ACRE OF PLANTING AND CULTIVATING SWEETPOTATOES USING DIFFERENT RATES OF 6-8-4 AND DIFFERENT PLANT SPACINGS

Pounds 6-8-4 to the acre	Plant spacing in row, inches	Fertilizer	Plants	Plowing, preparing	Planting, fertilizer application	2 hoeings, 3 cultivations	Total fixed costs
500	9	$6.70	$16.60	$4.12	$6.47	$5.50	$39.39
500	12	6.70	12.45	4.12	4.91	5.50	33.68
500	18	6.70	8.30	4.12	3.36	5.50	27.98
1000	9	13.40	16.60	4.12	6.72	5.50	46.34
1000	12	13.40	12.45	4.12	5.16	5.50	40.63
1000	18	13.40	8.30	4.12	3.61	5.50	34.93
1500	9	20.10	16.60	4.12	6.97	5.50	53.29
1500	12	20.10	12.45	4.12	5.41	5.50	47.58
1500	18	20.10	8.30	4.12	3.86	5.50	41.88

spacing; at the 1000-pound rate of fertilization the highest net profit likewise came from the 9-inch spacing; but at the 1500-pound rate the highest net profit came from the 12-inch spacing. Generally, the yield was greater with 1000 pounds of fertilizer per acre but when the rate was increased to 1500 pounds the further increase in production was small. Net profits were highest from 500 pounds fertilizer per acre, next highest from 1000 pounds, and lowest from 1500 pounds. The highest profit for the year, $34.34 from 9-inch spacing and 500 pounds fertilizer, was only slightly more than the profit of $33.70 secured from 9-inch spacing and 1000 pounds fertilizer, and $32.22 from 12-inch spacing and 500 pounds of 6-8-4 fertilizer.

The tests were located in 1940 on a fertile Cahaba fine sandy loam soil, planted May 9 and harvested October 6. As shown in table 13, somewhat lower yields were secured, and as a whole profits were somewhat less. The highest yields were secured from 9-inch spacing and 1500 pounds of 6-8-4 fertilizer. The highest profit, $31.09, was secured from 12-inch spacing and 500 pounds of fertilizer. This was followed in order by a net profit of $28.76 from 18-inch spacing and 500 pounds of fertilizer; and $20.88 from 12-inch spacing and 1000 pounds of fertilizer.

In 1940, as in 1938, more profit was shown from 500 pounds than from 1000 pounds 6-8-4 fertilizer, and least profit was shown from 1500 pounds fertilizer.

In general, it is shown in table 14 that a higher yield of the jumbo size was

TABLE 13.—INFLUENCE OF PLANT SPACING ON PROFIT FROM TRIUMPH SWEETPOTATOES — LAUREL

Rate of 6-8-4, lbs. to the acre	Plant spacing in row, inches	1938		1940	
		60 lb. bu. to the acre	Net profit, dollars to the acre	60 lb. bu. to the acre	Net profit, dollars to the acre
500	9	339	34.34	263	17.93
500	12	303	32.22	289	31.09
500	18	254	27.26	268	28.76
1000	9	368	33.70	297	18.97
1000	12	314	27.66	283	20.88
1000	18	289	27.92	243	18.13
1500	9	329	18.27	304	12.83
1500	12	347	27.89	279	13.21
1500	18	292	21.63	265	16.38

TABLE 14.—DISTRIBUTION OF GRADES OF TRIUMPH SWEETPOTATOES, FROM DIFFERENT RATES OF 6-8-4 AND DIFFERENT PLANT SPACINGS —LAUREL

Rate of 6-8-4, lbs. to the acre	Plant spacing in row, inches	Bushels (60 lbs.) to the acre of U. S. grades				
		Jumbo	No. 1	No. 2	Culls	Total
			1938			
500	9	4	229	79	27	339
500	12	11	223	65	4	303
500	18	16	182	45	11	254
1000	9	23	233	81	31	368
1000	12	13	207	81	13	314
1000	18	27	181	44	37	289
1500	9	4	232	73	20	329
1500	12	13	225	62	47	347
1500	18	24	205	45	18	292
			1940			
500	9	17	182	53	11	263
500	12	10	195	54	30	289
500	18	28	183	42	15	268
1000	9	16	208	59	14	297
1000	12	38	177	49	19	283
1000	18	30	172	27	14	243
1500	9	54	186	49	15	304
1500	12	58	179	32	10	279
1500	18	46	179	27	13	265

obtained from the wider spacing than from the higher fertilizer rates. This increase in jumbos was usually made at a sacrfiice of No. 2 grade and in some cases also at a sacrifice of the cull or string size grade. This is a desirable condition, although a high total yield is often associated with greater net profit.

Tables 9 and 12 were prepared to show the approximate portion of the total cost that must be attributed to plant spacing and to fertilization. 1000 pounds fertilizer cost twice as much as 500 pounds of a similar grade, and 1500 pounds cost three times as much. Only half as many plants are required for the 12-inch spacing as for the 6-inch spacing and similarily only half as much expense is involved in transplanting at the 12-inch spacing as the 6-inch spacing. Thus a nice calculation is involved before the profit or lack of profit in either of these two practices can be even approximately determined.

12-Inch Spacing, Moderate Fertilization, Appear Best

Experiments here reported show considerable variation in the yield, grade, and net profit secured from sweetpotatoes, attributable to plant spacing and quantity of fertilizer applied. Throughout, however, it will be observed that the 12-inch or closer spacing is either more profitable or is but slightly exceeded in profit by wider spacings. The regularity with which the 12-inch spacing appears at the top of the profit column is striking in all of the tables showing results of spacing tests with the Porto Rico or table variety.

The case for the medium close spacing is not quite so clear in tables showing results from the Triumph or starch variety. Here the "field run" crop has a given value by the bushel or ton, and there is neither premium for high quality nor discount for low quality. Perhaps local factors, including plant supply and planting facilities, are important in determining the most desirable spacing of Triumph for starch production, or for dehydration, or for stock feed.

This work was primarily concerned with plant spacing but it necessarily included quantities and grades of fertilizer commonly used in sweetpotato growing. More extensive fertilizer investigations might show more profitable ratios of nitrogen, phosphorus, and potash and probably would more definitely indicate the quantity most profitable. It seems important, however, that the 1000-pound and 1500-pound fertilizer applications were but slightly, if any, more profitable than the 500-pound applications of 6-8-4 or 4-8-4 fertilizer.

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Owner Farm Families in Poor Agricultural Areas

and

Cropper Farm Families in Rich Agricultural Areas

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SUMMARY AND CONCLUSIONS

The data of this study were drawn from two other studies and include information concerning incomes and expenditures of 83 white farm owner families residing in poor agricultural areas of Mississippi, and 111 white sharecropper families residing in the Yazoo-Mississippi Delta. All were young farm families with wife 17-35 years of age. In all the husband and wife had been married at least one year. None had received relief in cash or kind during the report year.

Owner families had on the whole somewhat higher incomes than did cropper families, but the greatest difference in these two groups was not in amount of income, but in source of income. The croppers had a larger proportion of their income in the form of cash derived from the sale of crops; the owners had a larger part of theirs in the form of farm-furnished goods and in cash from work off the farm.

No significant relation was found in tenure and total value of family living, when income and family type were held constant, but significant relationships were found in value of housing and in cash expenditure for food and for household operation; such as fuel, laundry soap. Landowners in poor soil areas, other factors constant, lived in better houses and spent less for food and household operation because more of these products were furnished by the farm.

There is need for further studies among owners on poor soils and croppers on good soils to determine whether the differences in family living are in the main due to differences in composition of income as in the case of the groups here included. Especially are such studies needed of older white families and of negro families. Then, too, the psychological aspects of ownership need investigation. What are the satisfactions which the owner receives not received by the cropper? Can any of these be supplied the cropper, and if so, how?

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Appendix 17

Owner Farm Families In Poor Agricultural Areas and Cropper Farm Families In Rich Agricultural Areas

by

DOROTHY DICKINS

There has been much discussion about the situation of the cropper family in rich agricultural areas and many alternatives suggested, such as, for instance, farm ownership on poorer areas. Is this alternative to be recommended? Rather, would it not be better to center attention on improving share cropping in rich areas?

Data secured by personal interview with 83 white farm owner families in poor agricultural areas and 111 white sharecropper families in rich agricultural areas furnish an answer at least in part to these important questions. The data were obtained from the farm owner families in 1938-39 in connection with a study of farm and factory women soon to be reported by the author.[1] The data concerning the cropper families were a part of the nation-wide Consumer Purchases Study made in 1935-36.[2]

Description of Areas

The owner families of this study resided in Attala, Clarke, Forrest, Itawamba, and Lauderdale Counties, Mississippi, which counties are classified by the Land Utilization Division of the Bureau of Agricultural Economics as in the group of forty counties of the State least suitable for arable agriculture. The cropper families of this study resided in Bolivar, Leflore, Sunflower, and Washington Counties. The Land Utilization Division of the Bureau of Agricultural Economics classifies these counties as having no striking general problem in agriculture.

General farming with cotton the main cash crop was the type of farming usually carried on by the landowners in the poorer agricultural areas. The richer agricultural areas in which the croppers resided included some of the finest cotton growing land in the nation.[3]

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[1] "Some Contrasts in the Level of Living of Women Engaged in Farm, Cotton Textile, and Cotton Garment Plant Work."

[2] Copies were obtained of schedules of white cropper families with wife 17-35 years of age of Bolivar, Leflore, Sunflower and Washington Counties, Mississippi.

[3] The areas from which the families were drawn were similarly selected. Maps showing network of roads and location of farm homes were secured. Cities, towns, and villages were blocked off and the areas remaining were divided into a large number of small subdivisions each including from 15 to 20 homes. The number of houses in each subdivision varied somewhat since boundaries of subdivisions depended upon roads, creeks, and other landmarks. The subdivisions were then numbered consecutively, working back and forth from one side of the map to the other. After the subdivisions were numbered, every fourth subdivision was marked to be included in each sampling period. The families of the farm-factory woman project were secured in one sampling period; those of the Consumer Purchases Study in two sampling periods.

Description of Families

As has been stated, the schedules of the owner families were obtained in connection with another study made in this department. In this study, only families with wives 17-35 years of age had been included. Schedules of white cropper families with wives 17-35 years of age only were secured. This was necessary to put the families on a comparative basis. This report is, therefore, concerned with white owner families residing on poorer soil areas and white cropper families residing on richer soil areas with wife 17-35 years of age. None of these families had received aid from any agency, public or private, during the report year. In all of these the husband and wife had been married at least a year and had kept house during the report year.

What differences were there in the size and composition of these young self-supporting farm families? The owner families averaged 4.56 members, while the cropper families averaged 3.14 members. Wives of owners had on an average of 2.4 children, wives of croppers an average of 1.2 children. The average deviation of number of children of wives of owners from their mean number was 1.7 children. Number of children of wives of croppers deviated from their mean by .8 child.

The larger families of landowners can be explained in part by the difference in the ages of the wives in these two groups; the mean age of owner wives being 29.0 years, of cropper wives 24.8 years. Another explanation of the difference in the size of families may be the fact that white farm families in the poorer areas were according to the 1930 census somewhat larger than white farm families in the more fertile areas.

Family Income

Farm family income includes the income received by all family members from both agricultural and nonagricultural sources classified as follows: (1) net money income from the operated farm; (2) net increase or decrease in value of crops stored for sale and of livestock owned; (3) nonmoney farm income used for family living, i. e., value of housing, food, fuel, and other products furnished the family by the farm; and (4) net money income from sources other than the operated farm. Funds made available to the family through liquidation of capital assets or through the accumulation of debt are excluded from income.

Income Level of Owner and Cropper Families

Median income, the figure that marks the dividing line between the upper and lower halves of the distribution of families by income, was $718 for owners and $502 for croppers (see table a in the appendix). About two-thirds of the owner families and practically all the cropper families had incomes of from $250 to $1000 (table 1). In drawing comparisons between the incomes of these groups, however, it must be remembered that the schedules were obtained from the cropper families during 1935-36, and from the owner families during 1938-39. According to estimates of the Bureau of Agricultural Economics prices received by farmers during the latter period were about 15 percent less than during the former period. This means, of course, that there is a greater difference in the income of these two groups than the foregoing figures indicate. On the other hand, it must be remembered that the cropper families of this study are considerably smaller than are the owner families. When these families are classified on the basis of income per capita, there is, therefore, less difference than when classified on the basis of income per family (table 2).

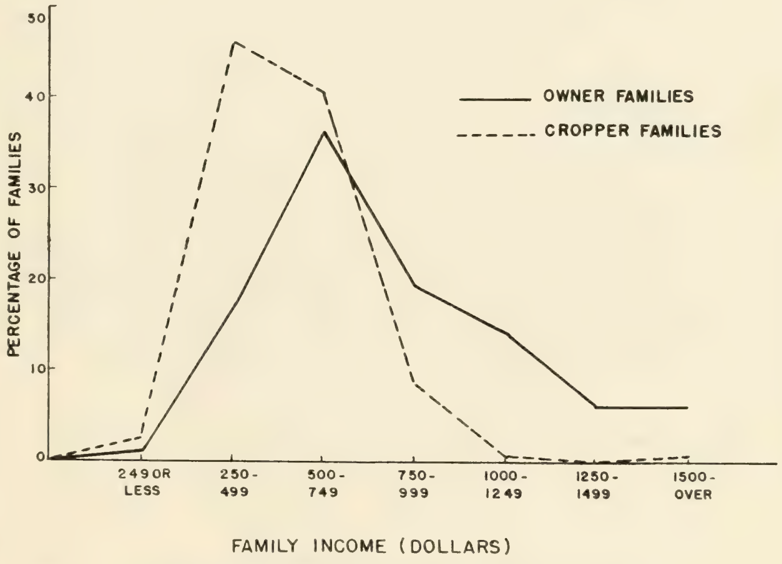

FIG. 1: PERCENTAGE OF OWNER AND CROPPER FAMILIES HAVING INCOMES OF SPECIFIED AMOUNTS.

Table 1. **Percentage Distribution of Owner and Cropper Families by Income**

Family income class (dollars)	Percentage of: Owner families	Percentage of: Cropper families
249 or less	1.2	2.7
250- 499	16.9	46.0
500- 749	36.1	40.5
750- 999	19.3	9.0
1000-1249	14.5	.9
1250-1499	6.0	0
1500 and over	6.0	.9
Number families	83	111

Table 2. **Percentage distribution of owner and cropper families by income per capita**

Family income per capita class (dollars)	Percentage of:	
	Owner families	Cropper families
100 and under	12.0	11.7
101-200	51.9	58.6
201-300	22.9	23.4
301-400	7.2	5.4
401-500	3.6	0
501 and over	2.4	.9
Number of families	83	111

Sources of Family Income

It would seem from foregoing figures that cropper families in rich areas had incomes on the whole somewhat lower than did a comparable group of owner families in poor areas. There were, however, a number of cropper families who had higher incomes than did a number of owner families. In order to determine reasons for differences in the incomes of these two groups it is necessary to know the amount of income derived from various sources. This information is given in table 3.

Owners of this study cultivated on an average 38 acres of land while croppers cultivated an average of 16.5 acres, but net income per acre cultivated (net money income from farming plus value of food produced for home consumption) was twice as great for cropper families. The net income per acre cultivated was for the owner families $15, for the cropper families $30. (See table b in the appendix.)

Table 3. **Average Amount of Income Derived from Specified Sources by Owner and Cropper Families Classified by Family Income**

Sources of income	Family income $499 & under		Family income $500-749		Family income $750 & over	
	Owners Dollars	Croppers Dollars	Owners Dollars	Croppers Dollars	Owners Dollars	Croppers Dollars
Average farm money income adjusted*	102.08	191.68	162.27	260.27	439.73	500.46
Average farm-furnished food	220.45	118.57	297.46	240.71	340.62	283.99
Average farm-furnished fuel and housing	70.16	47.62	71.96	54.01	94.97	48.54
Average nonfarm money income	89.84	27.41	89.75	51.90	292.94	105.02
Totals	482.53	385.28	621.44	606.89	1168.26	938.01
			Percentage distribution			
Average farm money income adjusted	21.2	49.8	26.0	42.9	37.6	53.4
Average farm-furnished food	45.7	30.8	47.9	39.7	29.2	30.3
Average farm-furnished fuel and housing	14.5	12.4	11.6	8.9	8.1	5.2
Average nonfarm money income	18.6	7.1	14.4	8.6	25.0	11.2
Totals	100.0	100.0	100.0	100.0	100.0	100.0

*Algebraic sum of net money income and net change in crops stored and livestock.

Difference in income from land cultivated by these two groups of families was, therefore, slight; but when differences in farm prices at the time of the study are taken into consideration, income from land cultivated by owners was somewhat larger though not greatly so.

The composition of the income from lands cultivated by these two groups, however, was quite contrasting. The cropper had a relatively higher proportion of this income in money from the sale of crops; the landowner in food for family consumption. Before production of cotton was restricted, the richer soils were used largely to produce cotton or a money crop. Families on poorer soils have always found general agriculture more feasible. Without doubt, many landlords, with the cotton reduction program in operation only a few years at the time of the study, had failed to develop a farm management plan best suited to this changed situation.

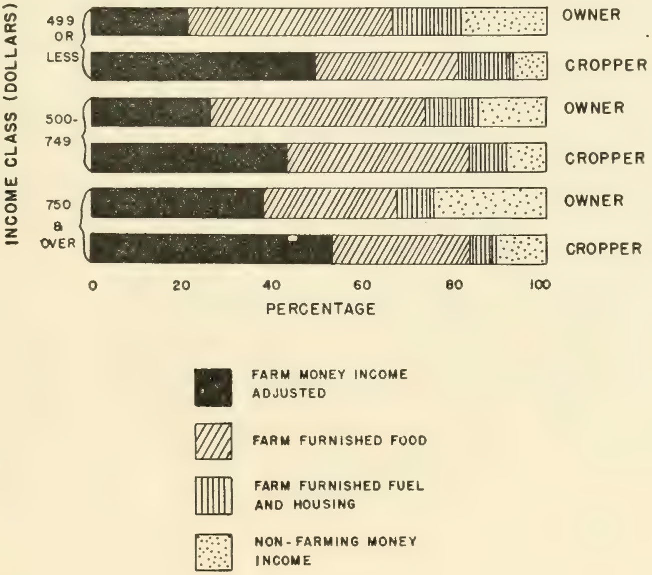

FIG. 11: PERCENTAGE DISTRIBUTION OF TOTAL FAMILY INCOME BY SOURCE FOR OWNER AND CROPPER FAMILIES CLASSIFIED BY INCOME

The median value of food produced and consumed at home was for owner families $296; for cropper families $174.[4] Values used for foods consumed at home were from 10 to 12 per cent lower for owner families. Owner families produced more of all types of food than cropper families, but a greater proportion of the total value of their supply consisted of milk and products, while a greater proportion of the croppers' total supply consisted of poultry and products. About 15 percent of the value of food produced by both groups consisted of vegetables. Value of food produced for family consumption per capita was most frequently for owner families from $50 to $75; for cropper families from $25 to $50. (See table c in appendix.)

One of the factors responsible for the better incomes of owner families was the fact that they more often secured work off the farm. About two-thirds of the owner-operators earned in this manner, earning on an average $227. Only one-half the croppers had such employment during the schedule year. An average of $74 was earned by those earning. Eight percent of the wives of owners and 4 percent of the wives of croppers earned. Land owner families, of course, have more influence and can, therefore, more often secure the little "extra work" available. Then, too, in a rich agricultural non-industrial area such as that in which the croppers resided, there was little "extra work" available. The differences in the non-farm earnings of these two groups cannot be attributed to a difference in schooling of members of these two groups, for the schooling which the husbands and wives received differed little, being only slightly higher for the owner group.

Value of Family Living

The median value of family living (including cash expenses for family living, value of housing and of farm products used by the family) was for owner families $649; for cropper families $505. Cash was used to secure only 37 percent of the value of goods consumed by owners. It was used to secure 56 percent of the value of goods consumed by croppers. In other words, croppers spent a larger amount of cash than did owners on family living but owners had a larger total value of goods because they produced more on the farm.

Significance of tenure to consumption

Although croppers spent more cash for family living than did owners, they had less cash to spend than did owners. (See table a in appendix.) Perhaps the fact that they had less cash to spend made home production less possible. That is, because they had less cash to spend they could not have as good home production program and because they did not have as good home production program they had to spend more cash.

The best method of determining differences in consumption of these two tenure groups is by variance analysis. The results of such an analysis are given in table f of the appendix. This analysis shows that owner and cropper families (Family types 1, 2, 3, 4, 5 of incomes $500-749) showed no significant differences in total value or in total expense of goods consumed for family living. In other words, the expenditure pattern of the Delta sharecropper and poor soil land owners of incomes $500-749 were not significantly different. There was, however, a highly significant relationship that could be attributed to tenure and rental value of houses occupied by these families and a significant relationship due to tenure in cash expenditures for food and for household operation. This may not, of course, be true at other income levels, but the number of cases at other income levels was too limited to make such analyses.

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[4] Estimated value obtained by multiplying the quantity of products used, as reported by the family, by a price estimated for each locality. Price estimates were based upon what a sample of farm families in the locality reported they would have paid had they bought products of the same quality and in the same quantity from neighbors, or from the most likely place of purchase. This method of evaluation gives a higher figure than that obtained when valuation is based on farm prices or wholesale market prices.

Table 4. **Percentage Distribution of Owner and Cropper Families by Total Value of Family Living**

Value of family living class Dollars	Percentage of: owner families	 cropper families
249 and under	0	.9
250- 499	26.5	48.7
500- 749	43.3	37.8
750- 999	16.9	9.0
1000-1249	12.0	.9
1250-1499	0	1.8
1500-1749	1.2	.9
Number of families	83	111

Food

Value per food-expenditure unit[5] per meal was for owner families $0.071; for cropper families $0.088. This does not mean that cropper families were better fed, however. Groceries, such as white flour, unbolted meal, lard, grits, rice, sugar, fat-back, black-eyed peas, canned syrup, coffee, salt and soda were purchased with the $10 a month in cash they spent for food. Only a very small amount of this cash was used to purchase meats or fruits and vegetables. Practically none of it was used to purchase dairy products. In other words, dairy products were not used by families with no milk cow.

Purchase of foods by owners was also limited to purchase of groceries, but here failure to purchase protective foods, such as dairy products, meat, fruits and vegetables, was not so serious since they produced more of these foods than did cropper families—about twice as many dairy products, twice as much pork, twice as much fruit, one-third more garden products.

With the data now available, it is not possible to state in exact terms the difference in the nutrients received by families in these two groups. One can state very definitely, though, that owner families had more protein, calcium and vitamin A in their diets, for their food supplies contained more dairy products and meat.

Diets of owner families were no doubt better, on the whole, than diets of cropper families, but diets of owners were none too good. One-third

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[5] The relative expenditure for food for different individuals based on the expenditure for food for the moderately active adult.

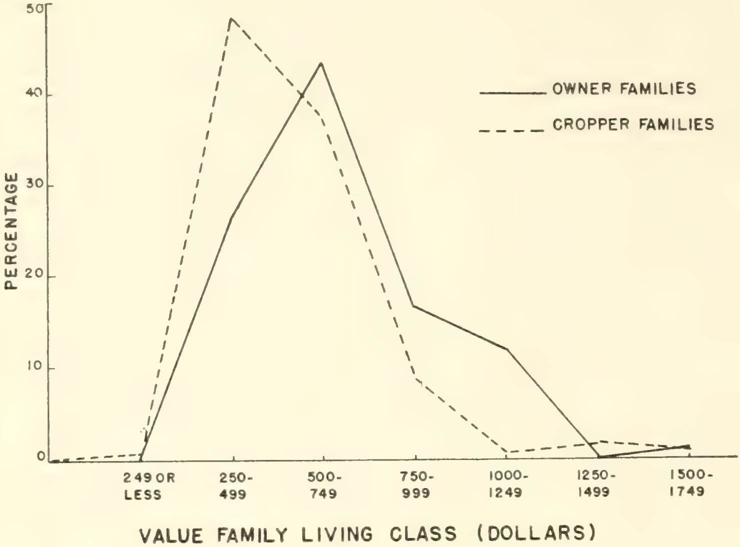

FIG. III: PERCENTAGE DISTRIBUTION OF OWNER AND CROPPER FAMILIES BY TOTAL VALUE OF FAMILY LIVING.

of the owners produced for family consumption less dairy products than recommended by the Nutrition Specialist of the Mississippi Agricultural Extension Service for families of their size and composition; one-half produced less pork and lard, and 85 percent produced less fruit.

Why should there have been a difference in food production by these two groups of farm families? There were probably a number of factors responsible, among which were: (1) The Delta landowner does not profit directly from a live-at-home program of his cropper. In fact, he may lose by giving land to his cropper for food crops that could be used for cash crops and by allowing time off during planting and harvesting for food production and preservation. The landowner on poor soils profits directly from a food production program. He saves cash that would otherwise be needed to purchase food. (2) A live-at-home program may be more difficult in the Delta. There is little pasture land on numerous plantations. The "gumbo" soil in some areas of this section makes fall gardening most difficult, although the sandy loam soils are excellent for gardening. (3) The owner on poor soils had more cash income, as well as more security for borrowing to furnish the capital necessary to carry on a successful food production program. (4) The owner families had no doubt more often sought advice from agricultural agents and teachers. (5) The philosophy of families in the two groups was doubtless different. The owner group had been accustomed to "live-at-home." To the cropper it was a new slogan. In the past, Delta land and cotton land were synonymous terms. The cropper expected enough money from farming to buy his food; the owner on poor soils had no such expectations.

Clothing and Personal Care

Both owner families and cropper families spent little on clothing and personal care, but at every income level, croppers spent more than did owners (tables d and e in the appendix) in spite of the fact that they had smaller families. The difference in the consumption of clothing and personal care items by these two groups at the income level of $500-749 was, however, not statistically significant. In other words, differences found may be due to chance rather than to tenure.

One cannot determine, however, from clothing and personal care expenditures alone which group was better groomed. The owner group spent less cash, but did more home sewing than the cropper group. Eighty-three percent of the owners had sewing machines. Only 46 percent of the croppers had machines. Then, too, in the poor soil areas in which the study was made, hair was often cut or set by some neighbor gratis. Neither group received gifts of clothing to any extent. Croppers received on an average $3.36 worth of clothing per family; owners about one dollar more.

The House

Owners of this study lived in houses with an average value of $490. Croppers lived in houses of an average value of $250. Differences in the value of the dwellings of these two groups were due to differences in size as well as condition of the houses. The average size of the houses occupied by owners was four rooms; of those occupied by croppers three rooms. Owned houses were given rental values of 10 percent of the present estimated value of the dwelling, while 12 percent of the present estimated value of the dwelling was used for houses of croppers. These were the same percentages as used in the Consumer Purchases Study and were based on interest rates, taxes, depreciation and a reasonable return on money invested. Seventeen percent of the homes of owners had electric lights; only one home of croppers had this convenience. Owners with homes wired all lived in the T. V. A. area and, therefore, secured this service very cheaply. Only two families, one owner and one cropper, had water in the kitchen.

In the statistical analysis made of the relation of the consumption pattern to tenure of families with incomes of $500-749 (table f in the appendix) the value of housing was the item of greatest significance. The landlord on rich soil who furnished good housing for his croppers does not get any more compensation than the landlord furnishing poor housing. He cannot collect for misuse of his property. On the other hand, the cropper who cares for the house of his landlord, who makes repairs or needed improvements will not be reimbursed for these should he move. He has no incentive to keep the house in good repair. The situation of the owner operator is, of course, different, but even for the owner operator repairs were limited because of low incomes. Several owners made structural additions to their houses during the report year which were considered an increase in assets, not an expenditure. Housing expenses were limited by owner families for the most part to repairs and replacements. Few carried insurance. Expenditures for rent, taxes and interest on the farm mortgage were not classified as housing expenses, but as farm business expenses.

Because cropper families of this study were smaller than owner families, they were only slightly more crowded than were owner families. Owner families averaged 1.02 rooms per person, while croppers averaged .94 room per person.

Cash expenditures for household operation (as for food) were closely related to tenure; cropper families spending more than did owner families. A number of cropper families had to purchase a part of their fuel for heating and cooking, especially for kindling wood. Many of the wooded areas in the rich Delta land have been cleared and this meant that the cropper had to purchase fuel more often than did the owner in poor agricultural areas. Then, too, wives of owners more frequently made their laundry soap than did wives of croppers.

Ice was the household operation expense in the use of which owner and cropper families showed the greatest difference, croppers using it in greater quantities than owners. There were several reasons for this. In the first place, the summer climate in the Delta is very hot and sultry, more depressing than in the areas in which the owners resided. The need for ice was, therefore, greater. Then, too, rural residents lived on thickly settled plantations in the Delta, the owners, in more thinly populated areas. Therefore, Delta ice companies may have found ice delivery to rural areas more profitable than did ice companies in the poor soil areas. Ice is not often purchased when one must go to town to get it. In the third place, the families in the poorer agricultural areas more often had springs and cisterns where food could be kept cool. Ice, however, was not used in the main for keeping food cool but for iced tea. Only 31 of the owner and 33 of the cropper families had ice refrigerators. Three owner families had mechanical refrigerators, all of these in the T. V. A. area. Croppers purchased more food than did owners, but most of the food purchased was not the kind that needed cold storage.

Cropper families spent more for household equipment at every income level than did owner families (See tables d and e in the appendix), but no significant relationship was shown between tenure and household equipment expense at the $500-749 income level (Table f in the appendix). Therefore, the relationship may not be significant for the other income groups.

Auto and Other Travel

Only 13 percent of the owner families and 7 percent of the cropper families with incomes of less than $500 owned automobiles. Expenditures for "other travel" were much more frequent for families of this income group. Many of these low income families, owners as well as croppers, made no expense either for auto or other travel, depending on walking or riding with friends and neighbors.

Owner and cropper families with incomes of $750 and over had expenses for auto more often than for other travel (See tables d and e in the appendix). More owners in this income group had autos, because of larger cash incomes. There was no significant difference in expenditures of the two tenure groups with incomes of $500-749 in expenditures for auto and other travel. With cash available, families in both groups would own autos. Thirteen percent of the owner families and 7 percent of the cropper families purchased automobiles during the schedule year, all of these secondhand autos except two.

Recreation and tobacco

Tobacco is classed here with recreation as it is a form of recreation, especially for low income families. In fact, the vast majority of families, owners as well as croppers, spent more for tobacco than for recreation. Expenditures for recreation were for the most part limited to a few toys for the children at Christmas time. Some of the men had expenses for hunting licenses and shells. A few families had expenses for radio or radio supplies. About 40 percent of the owners had radios. Only 14 per cent of the croppers had them. The fact that owners' families more often had electricity was one reason why they more frequently owned radios. One of the very first pieces of equipment installed after the house is wired is the radio. A battery radio is somewhat more expensive to operate and this deters many farm families, without electricity, from purchasing and explains non-use of many farm families with radios. "The batteries have run out" is an often-heard phrase.

The amount spent for commercial entertainment by owners and croppers was negligible.

Medical care

About nine-tenths of the owner families and nine-tenths of the cropper families had expenditures for medical care during the report year. Expenditures for medical care increased for both groups with an increase in income (See tables d and e in the appendix). No significant relationship was found in expenses for medical care and tenure.

Wives of 13 of the 83 owners and 20 of the 111 croppers had babies during the report year, which is about one in every six families with only a small difference in favor of the cropper families. Expenses for obstetrical care ranged from $20 to $35 for cropper families with the majority of families having expenses of $25. Expenses for such care for owner families ranged from $15 to $30 with most families paying $15. The majority of wives of landowners having babies during the schedule year lived in Itawamba County.

Change in Net Worth

Change in net worth of farm families was obtained by adding together the items representing an increase in assets and those representing a decrease in liabilities and subtracting from this the sum of decrease in assets and increase in liabilities. If the former sum was greater, an increase in net worth was obtained by the family; if the latter sum was greater, a decrease in net worth was sustained. Changes in assets and liabilities resulting from actual money transactions and net increases or decreases in value of crops stored for sale or of livestock owned were included in this statement.

About 80 percent of the share croppers had no increase or decrease in livestock or crops stored for sale. They owned several hens, a hog, and in some cases, a cow at the beginning and end of the report year, and that was all. Eighty percent of the owners had a net increase in livestock and crops stored for sale with an average increase of about $75.

Table 5. **Cash Incomes, Cash Expenses, Net Cash Surplus and Deficits and Change in Net Worth of Owner and Cropper Families, Classified by Income**

Item	$499 and under		$500 - 749		$750 and over	
	Owner families Dollars	Cropper families Dollars	Owner families Dollars	Cropper families Dollars	Owner families Dollars	Cropper families Dollars
Cash income	127.93	210.92	240.02	312.52	635.54	614.15
Cash expenses	155.22	229.85	207.55	322.12	435.96	662.65
Net cash surpluses and deficits[1]	—18.77	—7.19	15.63	—3.36	193.85	—50.77[2]
Change in net worth[3]	—21.87	—7.13	26.02	—6.17	299.72	—59.52

[1] Theoretically this figure should equal the difference between cash income and cash expenses. Actually it does not, because a balancing error of 10 percent was allowable on each schedule.

[2] One of the 12 families had a deficit of about $600. If this family had been left out the average change would have been 0.

[3] Includes net cash surpluses and deficits and change in livestock and crops stored for sale.

From table 5 it would seem that croppers were less likely to have an increase in net worth than were owners. However, the relationship of change in net worth and tenure for the $500-749 income group was not significant statistically speaking.[6] In other words, croppers, at least croppers of this study, cannot be placed in the thriftless category even though they did have deficits more often than did owners.

Sharecropping on Rich Areas Versus Ownership on Poor Areas

The following question was asked at the beginning of this report: "Is farm ownership on poorer areas preferable to cropping on rich areas?" This question can be answered only in part from the data of this study. From these data it would seem that ownership is preferable in the main not because of differences in income, but because of a difference in the form of income. The farm-owner family had a relatively greater proportion of its income in the form of non-money items. The value of its housing was greater. It had better food, because it produced more food on the farm. A program for putting the cropper on a comparable basis with the owner would, therefore, include ways and means of improving the food supply and housing.

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[6] The F value of tenure to change in net worth at $500-749 incomes was 5.5312.

APPENDIX

Table a. **Median Values of Specified Items Entering Into Income**

	Owners Dollars	Croppers Dollars
1. Farm money income, gross	263.50	277.74
2. Value food furnished	296.25	173.80
3. Value other products	35.00	30.00
4. Value family dwelling	40.00	22.00
5. Value of crops stored and livestock change	35.00	0
6. Farm income, gross	750.60	522.70
7. Farm expenditures	135.00	35.56
8. Farm income, net	599.25	466.36
9. Money income from other sources	51.30	16.00
10. Total family income	717.77	501.67
11. Money income from farming, net	157.00	230.82
12. Money income from all sources	295.99	271.10
13. Non-money income, farm, net	413.24	221.70
14. Sales cotton and cottonseed	135.00	230.00
15. Sales milk, poultry, livestock and products	55.00	10.00

Table b. **Percentage Distribution of Owner and Cropper Families by Net Income Per Acre Cultivated**

Net income*per acre cultivated (Dollars)	Percentage of: owner families	cropper families
Less than 5	2.4	—
5.00 — 9.99	22.9	1.8
10.00 — 14.99	26.5	5.4
15.00 — 19.99	22.9	16.2
20.00 — 24.99	10.9	12.7
25.00 — 29.99	6.0	18.9
30.00 — 34.99	4.8	17.1
35.00 — 39.99	1.2	9.9
40.00 — 44.99	1.2	6.3
45.00 — 49.99	1.2	2.7
50.00 and over	—	9.0
Number of families	83	111

*The sum of the net money income from farming and value of food products used by the family.

Table c. **Percentage Distribution of Owner and Cropper Families by Food Production for Home Consumption per Family Member**

Food production per capita (Dollars)	Percentage of: Owner families	Cropper families
Less than 25	2.4	10.8
25.00 — 49.99	24.1	32.5
50.00 — 74.99	36.2	27.9
75.00 — 99.99	21.7	19.8
100.00 — 124.99	12.0	5.4
125.00 and over	3.6	3.6
Number of families	83	111

Table d. **Owner Families of Three Income Groups Classified by Cash Expenditures for Family Living**

Cash expenses for family living	With incomes of $499 and under 15 families No. with	Av. for those with	Av. for group	With incomes of $500-749 30 families No. with	Av. for those with	Av. for group	With incomes of $750 and over 38 families No. with	Av. for those with	Av. for group
Auto	2	21.67	2.89	6	71.74	14.35	28	99.96	73.65
Other travel	7	12.21	5.70	17	7.97	4.51	10	6.15	1.62
Recreation	10	4.72	3.15	25	8.35	6.96	37	16.83	16.38
Reading	6	2.12	.85	19	2.35	1.49	31	4.12	3.36
Tobacco	13	8.47	7.34	24	10.44	8.35	32	17.03	14.34
Medical care	12	13.91	11.13	28	26.98	25.18	36	26.78	25.37
Personal care	15	3.67	3.67	30	4.63	4.63	38	11.34	11.34
Education	9	4.94	2.96	17	8.09	4.58	26	11.25	7.69
Gifts	11	6.13	4.50	29	10.31	9.96	37	15.94	15.52
Household equipment	5	31.33	10.44	16	12.74	6.79	31	35.03	28.58
Clothing	15	34.01	34.01	30	47.58	47.58	37	88.23	85.91
All other expenses	--	——	——	1	13.78	.46	3	47.38	3.74
Food at home	15	54.73	54.73	30	57.75	57.75	38	98.71	98.71
Food away from home	1	5.00	.33	1	8.40	.28	11	12.96	3.75
Housing	2	18.40	2.45	9	6.94	2.08	14	29.74	10.95
Household operation	15	11.03	11.03	30	12.35	12.35	38	28.73	28.73
Cash expenses family living	15	155.22	155.22	30	207.55	207.55	38	435.96	435.96

Table e. **Sharecropper Families of Three Income Groups Classified by Cash Expenditures for Family Living**

Cash expenditures for family living	With incomes of $499 and under 54 families No. with	Av. for those with	Av. for group	With incomes of $500-749 45 families No. with	Av. for those with	Av. for group	With incomes of $750 and over 12 families No. with	Av. for those with	Av. for group
Auto	4	53.39	3.95	9	48.81	9.76	6	179.32	89.66
Other travel	9	7.59	1.26	10	7.03	1.56	3	4.11	1.03
Recreation	37	7.96	5.45	41	10.02	9.13	12	13.66	13.66
Reading	16	2.86	.84	28	5.36	3.33	10	4.89	4.08
Tobacco	43	8.89	7.08	39	12.84	11.12	11	16.69	15.30
Medical care	47	20.43	17.78	41	25.91	23.61	12	74.61	74.61
Personal care	54	5.73	5.73	45	10.16	10.16	12	18.53	18.53
Education	8	4.03	.59	15	7.83	2.61	3	7.17	1.79
Gifts	40	5.32	3.94	42	9.69	9.04	12	19.23	19.23
Household equipment	51	6.97	6.59	45	18.53	18.53	12	60.48	60.48
Clothing	54	41.30	41.30	45	65.18	65.18	12	113.09	113.09
All other expense	28	6.76	3.51	22	17.17	8.39	4	71.67	23.89
Food at home	54	114.39	114.39	45	120.40	120.40	12	152.67	152.67
Food away from home	20	5.22	1.93	23	10.62	5.43	8	28.14	18.76
Housing	3	2.79	.16	—	——	——	2	9.00	1.50
Household operation	53	11.33	11.12	45	25.41	25.41	12	46.87	46.87
Cash expenses family living	54	229.85	229.85	45	322.12	322.12	12	662.65	662.65

Table f. Significance of Tenure to Consumption (Family Types I-V, $500-749)

Item	F value for tenure[1]
Auto expense	.0024
Other travel expense	2.0365
Recreation expense	1.3371
Reading expense	3.9972
Tobacco expense	.0001
Medical care expense	.3595
Personal care expense	4.3163
Education expense	.5816
Gifts expense	.8397
Household equipment expense	1.5004
Clothing expense	4.1250
All other expenses	1.2200
Food expense	19.8703*
Housing expense	4.1460
Household operation expense	7.7530*
Food value	1.8873
Housing value	123.7223**
Household operation value	3.2453
Total cash expenses family living	5.0794
Total value family living	3.4646

[1] 7.71=F value of tenure that may be expected due to chance variation alone once out of 20 trials. 21.20=F value of tenure that may occur due to chance alone once out of 100 trials. If F value obtained for tenure lies between 7.71 and 21.20, the result is significant and is designated by *. If F value obtained for tenure is larger than 21.20, the result is highly significant and is designated by **. Family type was held constant and the mean values were used for variance analyses as the number of cases in each family type varied. See "Statistical Methods," George W. Snedecor, Chap. 4, 6 and 10.

Bulletin No. 360 June, 1941

Fruiting of Cotton

In Relation to Cotton Fleahopper and Other Insects Which Do Similar Damage to Squares

By

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SUMMARY AND CONCLUSIONS

The total number of squares removed from the plots which had the squares removed for four, five and six weeks was greater than the number of blooms produced by the checks.

The number of blooms produced was not materially reduced by any treatment and in most of the cases was greater than that of the checks. In those cases where there was a reduction in the number of blooms produced there was no reduction in yield.

The blooming period on those plots which had the squares removed was shorter than that of the checks even when the squares were removed for only one week.

The height of the plants consistently increased with the increase in the length of the period during which the squares were removed.

The average number of bolls produced by the treated plots equalled or exceeded number produced by the checks in nineteen of the twenty-one cases.

In general, more bolls were required to make a pound of seed cotton on the treated plots than on the checks.

The staple length of those plots which had the squares removed for one and two weeks was shorter than that of the checks in only one case of eight. The staple length of those plots which had the squares removed for more than two weeks was approximately one thirty-second of an inch shorter in a majority of the cases.

There were only four cases in twenty-one where the yield of the treated plots was less than that of the checks. None of these losses in yield was statistically significant.

No evidence was obtained which indicates that it is necessary under Mississippi conditions to protect the young squares before the first week in July in order to produce a "good crop" of cotton for the prevailing environment conditions.

In view of the other factors involved, control measures should be applied during the first week in July if there is not a decided decrease in the insect populations. Finely ground sulphur dust at the rate of 10 pounds per acre is one of the cheapest and most effective insecticides for controlling the cotton fleahopper and other insects doing similar damage.

A mixture of one part of calcium arsenate and two parts of dusting sulphur at the rate of 15 pounds per acre may be used in cases where it is also desirable to control the boll weevil. Ordinarily, two applications should be sufficient for fleahopper control.

Fruiting of Cotton in Relation to Cotton Fleahopper and Other Insects Which Do Similar Damage to Squares

A. L. HAMNER, Associate Entomologist [1]

The reaction of the cotton plant to the removal of small squares, the size blasted by the cotton fleahopper and other insects which do similar damage, shows that it has the inherent capacity to overcome this loss. This was verified when plants, which had all of the squares removed at weekly intervals through the third week in July, nevertheless produced good yields.

Economic Importance of Insect Damage

The economic importance of the loss of young squares early in the season due to insect damage has been questioned by some workers in cases where the weevil infestation was not heavy later. It was evident that if the plants could overcome the early season loss of young squares, control measures at that time would be needed only when the infestation was so heavy that the growing points of the plants were being killed. There was also the probability that the fruiting period would be shortened to some extent, and if so, the period during which the fruit would need protection from insect damage would also be shortened. A better knowledge of the ability of the plant to produce a crop after it had been deprived of its squares until late in the season was also desirable.

A rather heavy infestation of the cotton fleahopper occurred generally over Mississippi in 1926. During the succeeding years the occurence of this insect in relatively large numbers has been restricted to a small number of fields at various places in the state. Since heavy infestations of the cotton fleahopper and the other insects which do similar damage have not occurred close to State College for several years, the importance of protecting the squares for periods of one, two, three, four, five, and six weeks after square production starts has been determined by simulating the damage. The work reported herein should not be construed to mean that the plant will react in the same way to infestations so severe that vegetative buds are destroyed.

The adult cotton fleahopper, **Psallus seriatus** (Reut.), is a small greenish-white insect about one-eighth of an inch long and somewhat oval in shape. It is quite active and usually flies to another plant when disturbed. The young insect or nymph is about one-thirty second of an inch long when newly hatched and light green in color. The shape of the nymphs is similar to that of the adults,

The adults and nymphs are usually easy to find on goatweed, horsemint and the primroses during late spring and summer. They are most easily found on cotton by a careful examination of the terminal buds.

The principal effect of the feeding of the cotton fleahopper and insects which do similar damage is the blasting of the young squares.

Review of Literature

Several American and foreign workers have shown that the cotton plant reacts to the removal of squares or flowers during the early period of fruiting by increased vegetative growth and squares production. Eaton (1) working in Arizona with Acala upland and Prima Egyptian varieties found that both varieties produced a substantial increase in the number of bolls when all of the flowers were removed during the first 25 days of the flowering period.

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[1] Mr. J. F. O'Kelly, Agronomist and Plant Breeder, arranged for the plot of ground and cultivation of the cotton.

Painter (5) in his studies of the effect of the cotton fleahopper and King (4) and Ewing (2) in their studies of the effect of the tarnished plant bug, **Lygus pratensis** (L.), and the rapid plant bug, **Adelphocoris rapidus** (Say), in addition to the cotton fleahopper, found that the injury from the feeding of these insects is local and extends only a short distance from the place where the insect feeds. The cage work of Ewing and McGarr (3) showed that the plants continued to develop fruiting positions and squares when the infestation in the cages was kept "up to a standard, which might ordinarily be called 'a heavy infestation' ".

Thomas (6) states, "—the shedding or blasting of early squares may be overcome by the development of a late summer and early fall crop, provided the flea hoppers leave the cotton and the boll weevils and leafworms do not cause trouble."

EXPERIMENTAL METHODS EMPLOYED IN TEST

One row, one hundred feet long, was used as a plot in 1936. During the three succeeding years one row fifty feet long was used. In 1936 and 1937 the seed were planted with a hill-drop planter. The cotton was thinned to the stand used in the variety and other tests on the Station farm. After the plants had become established and made some growth, the skips were measured in each plot. A space of more than two and one-half feet was considered a skip in 1936. This was reduced to two feet in 1937. The skips were then adjusted so that each plot of each individual block had the same number of the same length. In 1938 and 1939 the seed were planted by hand at intervals of one foot. The stand was reduced to one plant to a hill, just before or at the time when the first plants had visible squares.

The treatments were replicated seven times in 1936 and six times in each of the succeeding years. The plots were arranged according to the restricted randomization method.

The day on which approximately fifty percent of the plants had visible squares was arbitrarily accepted as the time at which fruiting started. It was necessary to allow the squares to grow about three days after visible appearance before they could be removed by hand with any speed. The weekly periods were therefore started on the fourth day after fruiting began.

Squares Removed at Intervals

Square removal was started on the sixth day of each week. The plots which were to receive the last treatment at the end of any period had the squares removed the sixth day and were then checked on the seventh day for any squares that had escaped notice or had grown sufficiently to be removed.

The squares were removed by either pinching them out with the finger nails or pressing them to one side, thereby breaking them off. Very little injury resulted to the growing points.

The cotton was fertilized at the rate generally used by the Station.

The varieties used were D. & P. L. 4-8 in 1936 and Cleveland 54 in 1937, 1938 and 1939.

The plan of the experiment called for the elimination of all factors, as far as possible, except the loss of squares and the injury incidental to the removal of squares. For that reason all of the plots were dusted as often as necessary to keep the insect infestation as near a minimum as possible.

Six Treatments Compared

The treatments used were as follows:

Treatment number*	Treatment
Check	No squares removed.
1	All squares removed at end of first week.
2	All squares removed at weekly intervals for two weeks.
3	All squares removed at weekly intervals for three weeks.
4	All squares removed at weekly intervals for four weeks.
5	All squares removed at weekly intervals for five weeks.
6	All squares removed at weekly intervals for six weeks.

*Hereafter used to designate each treatment.

SIMULATED DAMAGE AFFECTS SQUARES, BLOOMS, PLANTS

Squares Removed Per Foot of Row

With the exception of 1937 all of the square removal dates were comparable for each treatment. The cotton used in 1937 was planted late, which resulted in a three weeks' delay in the start of fruiting as compared with the other three years.

The potential ability of the plant to produce new fruiting positions and squares is shown by treatments 4, 5 and 6 in those years, 1936, 1938 and 1939, when the treatments were comparable for both the stage of growth of the plants and the season. The number of squares removed for each of these treatments exceeded the number of blooms (table 2) produced by the checks.

TABLE 1.—AVERAGE NUMBER OF SQUARES REMOVED PER FOOT OF ROW AND THE DATES ON WHICH THE LAST SQUARES WERE REMOVED.

	Treatment						
Year	Check	1	2	3	4	5	6
	Average number of squares removed per foot of row						
1936	000	5.1 (6/17)*	13.1 (6/24)	25.3 (7/1)	38.5 (7/8)	59.6 (7/15)	87.2 (7/22)
1937	000	10.2 (7/8)	24.6 (7/15)	43.7 (7/22)			
1938	000	5.5 (6/21)	15.9 (6/28)	27.5 (7/5)	48.7 (7/12)	73.2 (7/19)	92.1 (7/26)
1939	000	1.3 (6/22)	5.8 (6/29)	16.8 (7/6)	34.3 (7/13)	48.6 (7/20)	73.9 (7/27)

*Dates on which last squares were removed are in parentheses.

TABLE 2.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE NUMBER OF BLOOMS.

	Treatment						
Year	Check	1	2	3	4	5	6
	Average number of blooms per foot of row						
1936	34.7	34.4	35.3	34.2	33.7	31.8	34.2
1937	32.0	33.0	35.0	40.2			
1938	24.2	28.9	34.3	34.5	33.3	30.7	32.5
1939	25.1	27.1	30.1	34.3	41.3	40.9	34.9

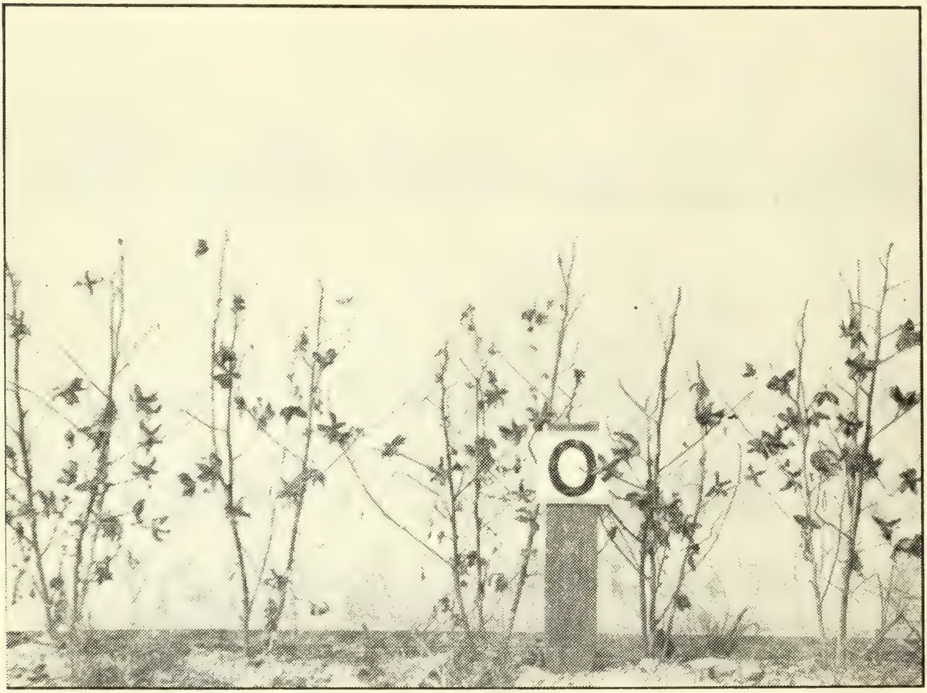

FIGURE 1.—NO SQUARES REMOVED. PHOTOGRAPHED FROM APPROXIMATELY SAME DISTANCE AS FIGURE 2.

Bloom Production Persistent

The data in table 2 were obtained from bloom counts made daily throughout the blooming period of the plants except on the check plots in 1936 when the first few blooms were not recorded. There was a tendency for the plants of each treatment to produce more blooms than the check in every year except 1936. A different variety of cotton was used in that year but there was no difference in the general treatment. An examination of the yield records (table 8) shows that the yield of seed cotton was not directly associated with the number of blooms produced.

Shorter Blooming Period, Trend

The blooming period was determined in 1936 from the dates on which all of

TABLE 3.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE LENGTH OF THE BLOOMING PERIOD.

	Treatment						
Year	Check	1	2	3	4	5	6
	Average blooming period in days						
1936	56*	47	41	38	35	30	32
1937	60	49	46	57			
1938	53	46	43	40	33	29	31
1939	60	55	50	48	40	38	41

* The first blooms were not recorded for the checks in 1936.

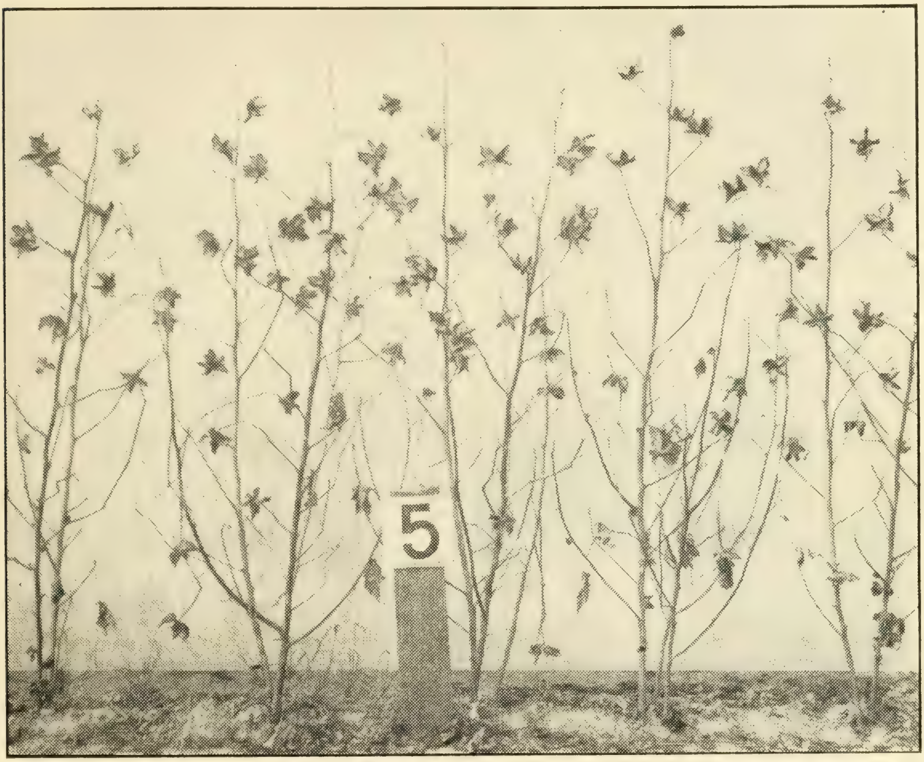

FIGURE 2.—SQUARES REMOVED FOR FIVE WEEKS. NOTE TALLER, WELL-FRUITED PLANTS.

the plots had at least one bloom, except on the untreated plots where the first blooms were not counted. If the initial date had been determined on the check plots, the period would have been longer than is shown in the table. The interval between the days when one-half the plots had one bloom per plot was used in 1937, 1938 and 1939. By these methods it was possible to designate both the beginning and the end of the blooming period on days when a rate of as few as approximately 150 blooms occurred per acre.

The definite trend toward a shorter blooming period is shown (table 3) by all of the treatments within an individual year. That more fruiting positions

TABLE 4.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE HEIGHT OF THE PLANTS

	Treatment						
Year	Check	1	2	3	4	5	6
	Average height of plants, in inches						
1936	29	33	37	39	42	45	47
1937	34	36	39	42			
1938	25	29	37	42	46	48	49
1939	30	31	33	33	37	38	40

were produced in a shorter length of time by the larger plants in the treated plots is evidenced by the number of blooms recorded on them. However, the blooming period for treatment 6 in 1936, 1938 and 1939 and treatment 3 in 1937 indicate that the environmental conditions of late summer tend to increase the blooming period.

Higher Plants as Squares Removed

Measurements were made of one hundred plants in 1936 and fifty in 1937. All of the plants were measured in each plot in 1938 and 1939.

The average height of the plants (table 4) was affected by all of the treatments. The measurements show that the loss of squares caused an increase in the height of the plant which was consistent with the length of the period during which the squares were removed. As would be expected, the plants of treatments 5 and 6 which set their crop near the top of the plants (see Fig. 2) had a tendency to become top-heavy and fall over.

The removal of the squares also had a decided effect on the length of the branches. Although no measurements were made, it was obvious that the branches were longer on those plots which had the squares removed for the longer periods. (See Fig. 2.)

SQUARES REMOVAL AFFECTS BOLLS, STAPLE LENGTH

Slight Increase In Number Of Bolls

Though the average increase was not consistent, there was a general tendency for the plots which had the squares removed to mature a larger number of bolls than the checks. Any significant or insignificant increase in yield with the exception of treatments 2 in 1937, 5 in 1938 and 1 in 1939 may be attributed to the increase in the number of bolls produced. The plots of treatment 2 in 1937 did not produce as many bolls as the checks but an increase in the weight

TABLE 5.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE NUMBER OF BOLLS PRODUCED

	Treatment						
Year	Check	1	2	3	4	5	6
	Average number of bolls picked per foot of row						
1936	12.8	14.0	14.9	15.3	16.1	16.0	16.8
1937	15.1	15.3	14.5	13.4			
1938	11.2	11.5	14.0	13.76	15.0	14.0	15.5
1939	12.5	13.4	13.3	12.9	14.0	14.7	16.2

TABLE 6.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE WEIGHT OF THE BOLLS

	Treatment						
Year	Check	1	2	3	4	5	6
	Average number of bolls required to make a pound of seed cotton						
1936	94	94	99.1	103.6	103.6	99.3	106.1
1937	93.7	93.4	88.5	90.4			
1938	91.6	96	101.1	98.7	95.8	90.8	94.5
1939	87.7	86.2	88.1	92.8	98.4	101.5	108.4

of the bolls offset the loss in the number of bolls produced. The increase in yield of the plots of treatment 5 in 1938 and 1 in 1939 was due to both an increase in the number of bolls produced and the number of bolls required to make a pound of seed cotton. There were three cases where the plots showed an increase, or a tendency toward an increase, in the number of bolls produced as compared with the checks but yielded less pounds of seed cotton per acre: namely, treatment 1 of 1938 and treatments 3 and 4 of 1939. The difference in yield of these treatments was not statistically significant, yet it does show that an increase in the number of bolls produced may not necessarily mean an increase in yield.

Slight Decrease In Boll Size

The number of bolls required to make a pound of seed cotton was calculated from the entire production of the plots. These data (table 6) show that in general more bolls were required to make a pound of seed cotton on the treated plots than on the checks. However, there was considerable variation in the number of bolls required to make a pound of seed cotton between treatments within a year and within treatments between years. No attempt was made to determine the percentage of the crop set during each weekly period of blooming, but the picking records indicate that the treated plots set their crop within a shorter period than the checks. The blooming periods (table 2) also show that the period during which the treated plots could set fruit was shorter than that of the checks. It has been shown that the available soil moisture is an important factor in the growth of bolls. Since it is evident that the weight of the bolls is not closely correlated with treatments, the available soil moisture very probably was an important factor which affected the growth of the bolls.

The difference in the weight of the bolls was apparently not due to early shedding of the leaves. In general, the check plots shed the leaves first and were followed by the treated plots in relation to the periods of square removal.

Trend Toward Shorter Staple

The staple length was determined by the combing method. The samples were taken at each picking as long as a fair sample could be obtained. All of the combings were made by the same person.

The data in table 7 show that with one exception, treatment 2 of 1936, the staple length was not affected by the removal of squares for the first two weeks (treatment 1 and 2) after fruiting started.

Although the reduction was small,

TABLE 7.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE STAPLE LENGTH

	Treatment						
Year	Check	1	2	3	4	5	6
Average decrease in staple length, as compared with checks							
1936	—	0	1—*	1+	2—	2—	1—
1937	—	0	0	1—			
1938	—	0	0	1—	1+	1+	1+
1939	—	0	0	+1—	1—	1—	1—

* 1— indicates a decrease of a short 32nd of an inch. 1+ indicates a decrease of a full 32nd of an inch. +1— indicates an increase of a short 32nd of an inch. 2— indicates a decrease of a scant 16th. Decreases of less than a 64th of an inch have been considered as equal to the checks.

there was a distinct trend toward a shorter staple of the other four treatments, as compared with the checks. There were only two of the thirteen cases where the reduction was as much as a scant sixteenth of an inch. Of the other eleven cases there were six which showed a reduction of a scant thirty-second, four with a full thirty-second and one which showed a scant thirty-second increase over the check.

YIELD MAINTAINED DESPITE REMOVAL OF SQUARES

The data show that a complete loss of young squares through the third week in July did not cause a statistically significant loss in yield of seed cotton when the fruit was protected from the boll weevil and other insects and the disease infection was negligible. The yields obtained from plots which had all of the squares removed through the second and third weeks in July (treatments 5 and 6) should not obscure the fact that such affected plants produce their fruit when it may be subjected to heavy boll weevil infestations and late summer drouths. Plants which have lost all of their squares for five and six weeks may also attain such heights that they become top heavy and fall over.

Difficulty may be experienced in gathering a crop that has been set entirely from squares produced after the second and third weeks in July. However, it is evident that in cases where the insect infestation is allowed to do serious damage to young squares until the second and third weeks in July the plant will respond to control measures and a crop of cotton can be produced if the boll weevil is controlled and diseases do not affect the plants.

Observations on the late planted cotton of 1937 indicated that the third week in July is the latest date after which plants that have lost all of their squares for two weeks or more can produce a crop of cotton if a killing frost occurs fairly early in the fall.

TABLE 8.—THE EFFECT OF THE REMOVAL OF SQUARES ON THE YIELD OF SEED COTTON

		Treatment					
Year	Check	1	2	3	4	5	6
		Average pounds of seed cotton per acre					
1936	1789	1948	1956	1941	2034	2108	2078
1937	2116	2147	2151	1931			
1938	1603	1568	1814	1820	2046	2027	2146
1939	1861	2036	1971	1810	1855	1896	1959

The mean difference required for a P. of .05 was 150 pounds in 1936; 200 pounds in 1937; 177 pounds in 1938; and 175 pounds in 1939.

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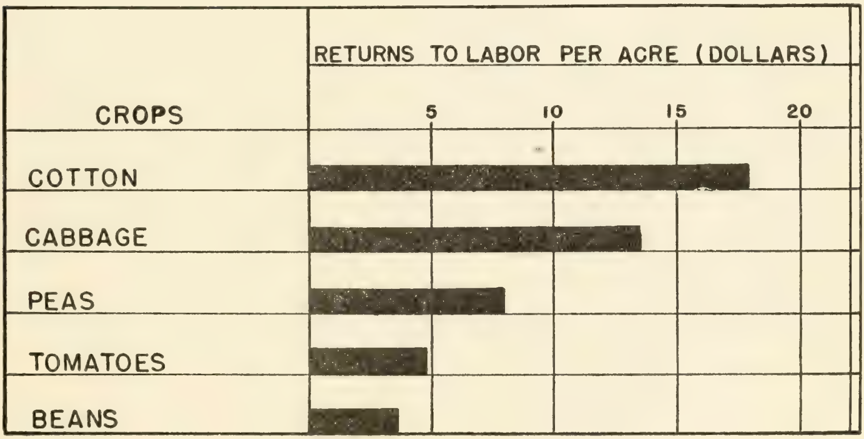
AN ECONOMIC STUDY OF TRUCK FARMING IN COPIAH COUNTY, MISSISSIPPI

1938-1940



Average Returns to Labor Per Acre For Different Crops, Copiah County, Mississippi, 1938-1940

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APPENDIX 33

SUMMARY

This study was made by taking survey records on 80 farms in Copiah County, Mississippi. This county is located in the southwestern part of the State and makes up the greater part of the truck farm area. This county alone provided 1/3 of the vegetables shipped from Mississippi during the period 1931-1940.

The average size farm in the survey had 131 acres total farm land and 55 acres of crops.

The average investment per farm was $4,950 in 1938, $4,198 in 1939, and $4,369 in 1940. Approximately three-fourths of this total investment was in real estate.

In terms of acres, corn was the most important crop grown. Corn accounted for 41 percent of the total acres of crops, cabbage 14 percent, cotton 13 percent and tomatoes 12 percent. Twenty-one acres, or 39 percent of the total acres of crops, were planted to truck crops.

Receipts per farm were $1,950 in 1938, $1,688 in 1939, $1,560 in 1940, and averaged $1,733 for the three years. Cabbage, tomatoes and cotton, in the order named, were the most important sources of farm receipts. The four major truck crops, cabbage, tomatoes, peas and beans, accounted for over one-half of the farm receipts in each of the years studied.

Expenses per farm were $1,702 in 1938, $1,467 in 1939, $1,441 in 1940, and averaged $1,537 for the three years. Labor and fertilizer were the most important items of expense, constituting 34 and 27 percent, respectively, of the total farm expenses.

The farm privileges per farm amounted to $305 in 1938, $299 in 1939, and $284 in 1940, and averaged $296 for the three years. The farm privileges exceeded the farm income $57 in 1938, $78 in 1939, and $165 in 1940.

The labor income per farm was $50 in 1938, $54 in 1939, minus $55 in 1940, and averaged $16 for the three years. The majority of the farms had a labor income within the range of minus $250 to $250. Forty-three of the 80 farms surveyed in 1938, 35 in 1939, and 46 in 1940, had a minus labor income.

Marketing efficiency and production efficiency were the most important factors in accounting for high incomes on some farms and low incomes on others. In each of the years studied the farms with the lowest marketing efficiency had the lowest labor income, and in all cases, except one, the farms with the highest marketing efficiency had the highest labor income. As production efficiency increased, labor income increased.

The twenty most profitable farms and the twenty least profitable farms were compared with regard to a number of factors. In 1938 and 1939 the most profitable and least profitable farms were approximately the same size, but in 1940 the least profitable farms were much larger. In each of the years studied the most profitable farms used capital more efficiently, had higher crop yields, secured higher price for products sold, and had a smaller percentage of cash receipts from truck crops and had a higher percentage of cash receipts from cotton and livestock than did the least profitable farms.

The five major cash crops were analyzed to determine the profitableness of each. Three measures of profitableness were used: (1) net returns per acre; (2) returns to labor per acre; and (3) returns per day of labor. The profitableness of the individual crops varied greatly from year to year, and a different crop was most profitable in each of the years studied. For this reason the average for the three years is given below.

The average net returns per acre were: cotton $5.26, cabbage $2.16, peas minus $4.84, beans minus $6.60, and tomatoes minus $14.26.

The average returns to labor per acre were: cotton $17.61, cabbage $13.62, peas $8.01, tomatoes $4.92, and beans $3.53.

The average returns per day of labor were: cotton $1.43, cabbage $1.18, peas $0.66, beans $0.35, and tomatoes $0.26.

It is evident that during the period studied farmers could not hire much labor and expect to make a profit on truck crops. Cotton and cabbage were the only crops on which farmers could hire all labor and make a profit. The fact that there was a wide variation in returns per acre from year to year and that a different crop was most profitable in each of the years studied probably explains why farmers continue to plant a given truck crop even though they might have lost money on it several years in succession.

An Economic Study of Truck Farming in Copiah County, Mississippi, 1938-1940

By

Marvin Guin and D. W. Parvin

INTRODUCTION

Truck crops are the most important source of income to farmers in Copiah County. Soil and climatic conditions are favorable to the production of a wide range of vegetables. The County is favorably situated with reference to labor needs. Seasonal labor needs can be easily met by drawing from surrounding farms and from nearby villages and towns.

For the past three years, the income to truck growers has been low due to low prices of commodities. The timeliness of marketing is an important factor in the sale of truck crops. A few days delay may mean the difference between prices that insure a profit and prices that mean an operating loss.

The objectives of the study are (a) to make an analysis of the farm practices within the County, (b) to determine the relative profitableness of individual farms, (c) to determine the cost of production of important crops, (d) and finally to indicate the farm management practices that have proved to be most successful.

Materials and Methods

Survey records of farm businesses for the years[1] 1938, 1939, and 1940 were obtained from 80 typical farmers. The majority of the farms surveyed were owner-operated. Only a few renters were interviewed and these were cash renters.

A detailed record of the year's farm business was secured each year, showing inventories, receipts, expenses, production and marketing practices, and the farm organization with respect to crops and livestock. An effort was made to obtain records on the same farms each year, even though the farm had changed operators. Through the assistance of the vocational agricultural teacher at Crystal Springs and representative shippers, an impartial selection of the farmers' names was secured, care being taken to secure a representative sample of the area studied. The object was to get a representative cross-section of the truck enterprise, avoiding too large a portion of either the better or poorer farms or farmers.[2] The data were obtained by personal interviews and based largely on careful detailed estimates made by the farmers; books and records were used whenever available. The location of the area studied is shown graphically in figure 1.

The U. S. Department of Agriculture Yearbooks and publications of the Bureau of Agricultural Economics were used in obtaining statistical data for the area.

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[1] The fiscal year began August 1 and ended July 31.

[2] Since the farms had an average of 1.5 share tenants and family, the definition of a farm in this study differs from the United States Census definition in which each tenant with three acres of land or agricultural products valued at $250.00 or more is called a farmer.

The farm records are analyzed from the standpoint of the farm as a business unit, and important business relationships studied and summarized. The most important truck crops in the county are described in detail and various practices pointed out.

Definition of terms

Acres Operated: The total amount of farm land operated as a unit.

Farm capital: The value of the real estate, livestock, equipment, feed, seed, and other supplies.

Animal unit: A mature horse or cow or the equivalent in other livestock based upon the amount of feed consumed and manure produced; 2 calves, heifers, or colts; 7 sheep, 14 lambs, 5 hogs, 10 pigs, and 100 hens are considered, respectively, as an animal unit.

Acres in crops: The number of acres of land used for crops during a season or year. If more than one crop is grown on any of the land during the year the acreage is counted but once in determining the acres in crops.

Acres of crops: The number of acres of crops planted or harvested during a year. If double cropping is practiced, the acres of crops will exceed the acres in crops.

Farm receipts: The receipts from crops, livestock, crops on hand for sale at end of year, livestock products sold, increase in inventory of livestock and in real estate and equipment, and miscellaneous receipts from man and horse labor, and rent. Government payments were included.

Farm expenses: Farm expenses actually incurred, such as for fertilizer, labor, ginning, repairs, decrease in feed and livestock inventories, and in equipment, and the value of unpaid family labor.

Farm income: The difference between total farm receipts and total farm expenses.

Labor income: The farm income, less 4 percent on the average investment. Labor income is what a farmer receives for his year's work in addition to interest on his investment, all farm expenses, having a house to live in and farm produce to use in the home.

Labor earnings: The labor income plus the value of the farm privileges. It represents the earnings of the labor of the operator.

Farm privileges: The value of food products and fuel furnished directly by the farm toward the family living. The value of the use of the house is not included.

Percent return on investment: Equals the farm income less the estimated value of the operator's labor, expressed as a percentage of the average investment.

Crop index: The weighted average yield of crops of any farm expressed as a percentage of the average yield of the area.

Price index: Expresses on a percentage basis the prices received by a particular farmer as compared with those received by all farmers included in this study.

Farm capital turnover: The ratio of the farm receipts to the farm capital.

Location and Description of Area Studied

Copiah County is located in the southwestern part of the State, in the Brown Loam and Coastal Plain soil areas. The most common soils are Norfolk, Memphis, Waverly, and Orangeburg. Norfolk, an ashy-gray upland soil with yellow clay subsoil, is fair for cotton, corn, legumes, and truck crops.

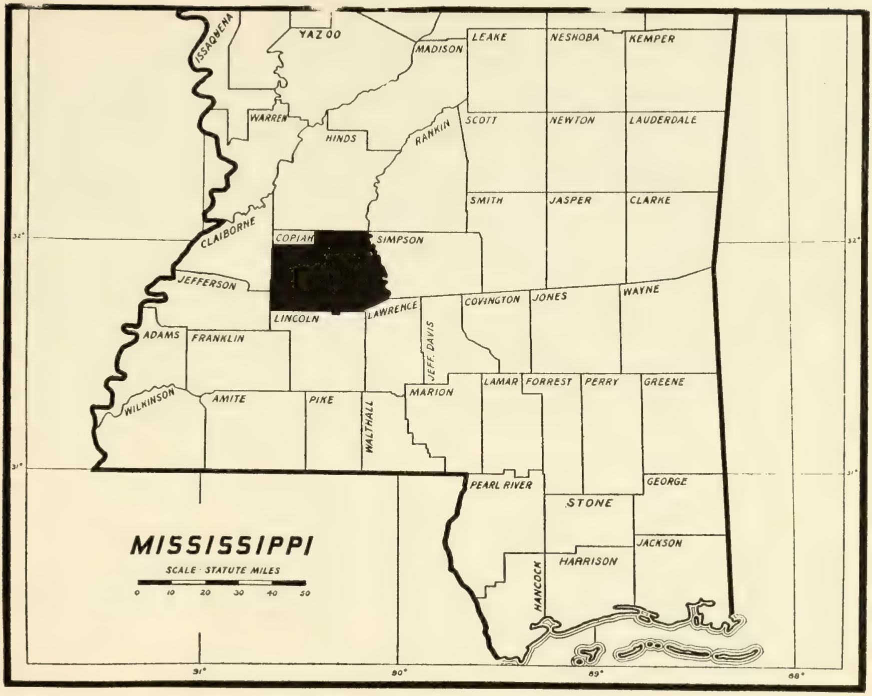
ISSAQUENA
YAZOO
MADISON
LEAKE
NESHOBA
KEMPER
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
LINCOLN
LAWRENCE
ADAMS
FRANKLIN
JEFF. DAVIS
WILKINSON
AMITE
PIKE
WALTHALL
MARION
LAMAR
FORREST
PERRY
GREENE
PEARL RIVER
STONE
GEORGE
MISSISSIPPI
SCALE · STATUTE MILES
0 10 20 30 40 50
JACKSON
HARRISON
HANCOCK
32°
31°
91°
90°
89°
88°

Figure 1. Location of area studied

Memphis, a brown to grayish-brown upland soil with buff-colored subsoil, found only in the brown loam and Loess formation, is a good soil adapted to truck crops, cotton, corn, and legumes, although it is often badly damaged by erosion. Waverly is a "crawfish" land. It is a fair soil, adapted to cotton, corn, and legumes. Orangeburg is well drained, reddish in color, and is one of the most productive upland soils in the State. It is adapted to vegetables, cotton, corn, small grain, legumes and fruit trees.[3]

Copiah County's topography is gently rolling to rolling. The climate permits the growth of truck crops in the late winter. The winters are mild and the summers long and warm. The mean temperature for the years 1928-1937 was 66°F, and the average annual precipitation during the same period was 52 inches. The average growing season was 234 days, and the average first killing frost occurred November 13, and the last on March 24.[4]

Crystal Springs and Hazlehurst are the principal shipping centers. Crystal Springs with a population of 2,887 in 1940[5] is the center of the truck farming industry.

Hazlehurst is the county seat with a population of 3,128 in 1940. The Illinois Central Railway and Highway 51 traverse the county.

Copiah County is the most important commercial vegetable producing area in the State. Seventy-four percent of the tomatoes, 86 percent of the cabbage, 94 percent of the green peas, 62 percent of the beans (snap and

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[3] J. S. Scott, Federal Land Bank, Soil Guide, New Orleans, La.

[4] R. T. Lindley, Climatological Data, U. S. Dept. of Agriculture Weather Bureau, 1928-1937.

[5] U. S. Census reports, 1940.

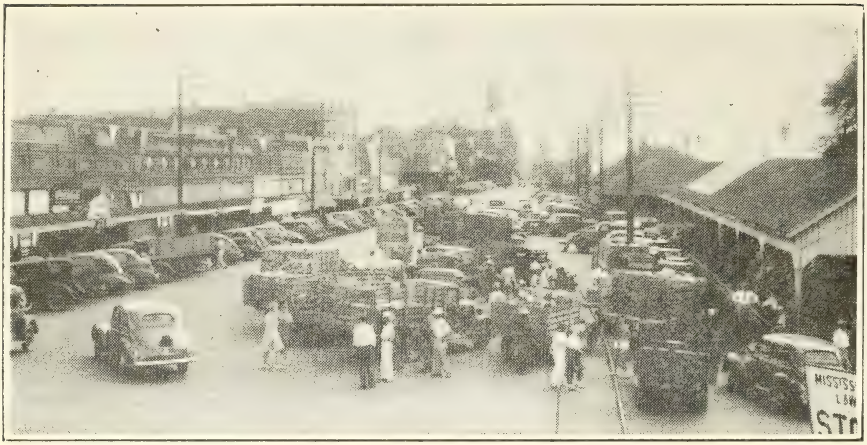

Figure 2. A common street scene during the truck crop marketing season, Crystal Springs, Mississippi

lima), and 93 percent of the peppers shipped from Mississippi for the 10-year period 1930-1939 came from Copiah County. The total shipments from Copiah County constituted 70 percent of the vegetables shipped from the State during this period.

FARM ORGANIZATION

Land Use

The average size farm surveyed was 131 acres, of which 37 acres, or 28 percent, was in crops. Eighteen acres, or 49 percent of the acres in crops were double-cropped giving a total of 55 acres of crops per farm (Table 1).

Table 1. Land Use, 80 Farms, Copiah County, Mississippi, 1938-1940

Year	Average per farm					
	Acres operated	Acres in crops	Acres of crops	Acres double-cropped	Percent of acres operated in crops	Percent of acres in crops double-cropped
1938	141	42	62	20	30	48
1939	121	34	52	18	28	53
1940	131	35	51	16	27	46
Average	131	37	55	18	28	49

The average size farm varied from 121 acres in 1939 to 141 acres in 1938. Acres in crops varied from 34 acres in 1939 to 42 acres in 1938; and acres of crops varied from 51 acres in 1940 to 62 acres in 1938. Twenty acres were double-cropped in 1938, 18 acres in 1939, and 16 acres in 1940. Thirty percent of the farm land was in crops in 1938, 28 percent in 1939, and 27 percent in 1940. Forty-eight percent of the acres in crops was double-cropped in 1938, 53 percent in 1939, and 46 percent in 1940. Practically 100 percent of the truck crops are followed by a second crop, usually corn, which accounts for the large acreage that is double-cropped. This is done in order to grow feed and to utilize the fertilizer that the truck crops failed to use.

Capital Invested

The average investment per farm was $4,506, or $122 per acre in crops. Of this total investment, 40 percent was in land, 35 percent in buildings, 8.6 percent in workstock, 8.5 percent in equipment, 7.1 percent in livestock and .6 percent in feed and seed (Table 2).

Table 2. Distribution of Capital, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average investment	Percent	Average investment	Percent	Average investment	Percent	Average investment	Percent
Land	$2,002	40.5	$1,735	41.3	$1,659	38.0	$1,799	39.9
Buildings	1,733	35.0	1,489	35.5	1,544	35.3	1,589	35.3
Workstock	465	9.4	305	7.3	397	9.1	389	8.6
Equipment	412	8.3	363	8.6	378	8.7	384	8.5
Livestock	308	6.2	278	6.6	369	8.4	318	7.1
Feed and seed inventory[1]	30	.6	28	.7	22	.5	27	.6
Total	$4,950	100.0	$4,198	100.0	$4,369	100.0	$4,506	100.0

[1] Inventory taken August 1.

The average investment per farm did not vary greatly during the period studied, ranging from $4,198 in 1939 to $4,950 in 1938. The percent that each item constituted of the total investment was likewise consistent from year to year. Real estate made up 76 percent of the total investment in 1938, 77 percent in 1939, and 73 percent in 1940; the percent of capital invested in workstock, equipment, livestock, and feed and seed varied even less. The investment per acre in land and buildings averaged $26 for the three years studied and did not vary greatly, ranging from $24 in 1940 to $27 in 1939.

Acres of Principal Crops

There was an average of 55 acres of crops per farm during the period studied (Table 3). Of this total acreage corn accounted for 41 percent, all truck crops 39 percent, cotton 13 percent, hay 6 percent, and miscellaneous crops 1 percent. Cabbage was the most important truck crop grown. Fourteen percent of the total acres of crops was devoted to cabbage, 12 percent to tomatoes, 4.5 percent to peas, 4.4 percent to beans and .7 percent to peppers.

Table 3. Acres of Crops, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Crops	Acres per farm	Percent	Acres per farm	Percent	Acres per farm	Percent	Acres per farm	Percent
Corn	24.2	39.0	21.8	41.9	21.4	42.1	22.5	40.9
All truck	23.7	38.2	21.3	41.0	18.5	36.4	21.2	38.5
Cabbage	8.2	13.2	7.8	15.0	7.5	14.8	7.8	14.2
Tomatoes	8.1	13.1	6.7	12.9	5.0	9.8	6.6	12.0
Peas	2.8	4.5	2.3	4.4	2.3	4.5	2.5	4.5
Beans	2.7	4.4	2.2	4.2	2.2	4.3	2.4	4.4
Sweetpotatoes	.9	1.5	.8	1.5	.6	1.2	.8	1.4
Peppers	.4	.6	.5	1.0	.4	.8	.4	.7
Irish potatoes	.2	.3	.3	.6	.2	.4	.2	.4
Miscellaneous truck	.4	.6	.7	1.4	.3	.6	.5	.9
Cotton	10.2	16.4	5.8	11.1	6.0	11.8	7.3	13.3
Hay	3.5	5.6	2.6	5.0	3.7	7.3	3.3	6.0
Miscellaneous	.5	.8	.5	1.0	1.2	2.4	.7	1.3
Total	62.1	100.0	52.0	100.0	50.8	100.0	55.0	100.0

In discussing the individual crops, the percent that a crop constitutes of the acres will be used instead of the number of acres, due to the fact that there was a variation of 11.3 acres of crops per farm between 1938 and 1940. The percent of acres of crops devoted to corn, peas, beans, and sweet potatoes did not vary greatly from 1938 to 1940. The percent of total acres de-

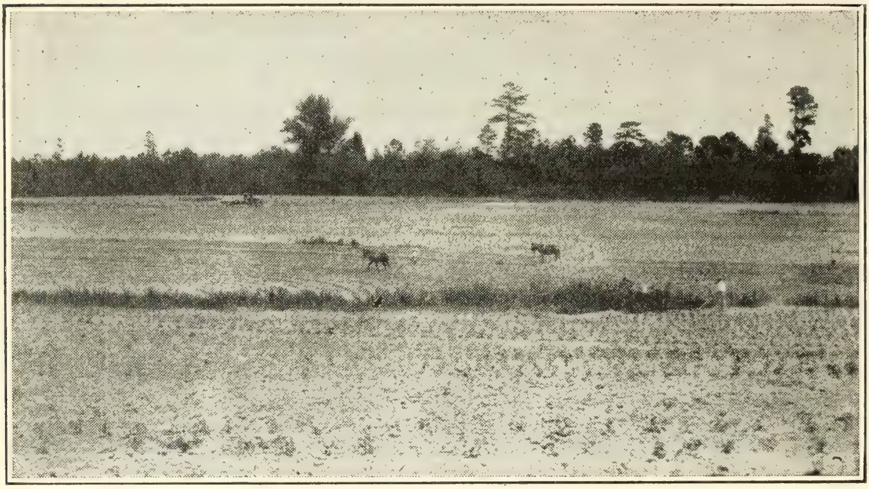

Figure 3. Typical method of cultivation in the truck crop area

voted to cabbage increased from 13 percent in 1938 to 15 percent in 1940, and the percent devoted to tomatoes decreased from 13 percent in 1938 to 10 percent in 1940. This indicates that farmers are replacing tomatoes with cabbage and other crops to some extent. The percent of land devoted to hay and miscellaneous crops increased from 1938 to 1940, while the percent of land devoted to cotton decreased.

Farm Receipts

Receipts per farm were $1,950 in 1938, $1,688 in 1939, $1,560 in 1940, and averaged $1,733 for the three years (Table 4). Cabbage was the most important source of farm receipts during the 3-year period. Cabbage accounted for 24 percent of the total farm receipts, tomatoes 19 percent, cotton 15 percent, peas 9 percent, beans 6 percent, livestock 10 percent and miscellaneous items 6 percent. The four major truck crops, cabbage, tomatoes, peas and beans, accounted for over one-half of the farm receipts in each of the years studied.

Table 4. Farm Receipts, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average farm receipts	Percent	Average farm receipts	Percent	Average farm receipts	Percent	Average farm receipts	Percent
Cabbage	$ 356	18.2	$ 508	30.1	$ 397	25.5	$ 420	24.2
Tomatoes	377	19.3	329	19.5	280	17.9	329	19.0
Cotton	401	20.5	178	10.5	183	11.7	254	14.7
Peas	231	11.9	119	7.1	90	5.8	147	8.5
Beans	103	5.3	62	3.7	130	8.3	98	5.7
Corn	78	4.0	60	3.5	65	4.2	68	3.9
Peppers	26	1.4	93	5.5	21	1.3	47	2.7
Sugarcane	22	1.1	20	1.2	27	1.7	23	1.3
Sweetpotatoes	31	1.6	17	1.0	20	1.3	23	1.3
Other crops	53	2.8	32	1.9	21	1.4	35	2.0
Livestock	180	9.2	169	10.0	186	11.9	178	10.3
Miscellaneous	92	4.7	101	6.0	140	9.0	111	6.4
Total	$1,950	100.0	$1,688	100.0	$1,560	100.0	$1,733	100.0

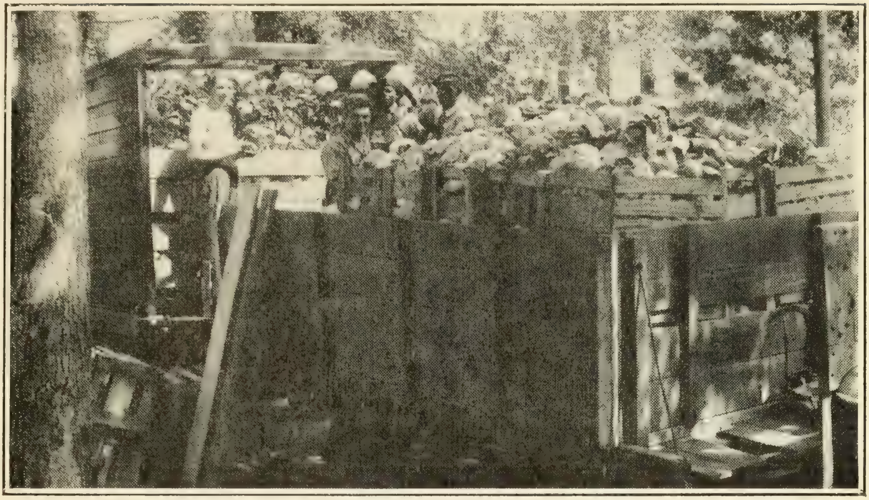

Figure 4. Reloading cabbage for transfer to central markets

Receipts from cabbage constituted 18 percent of the total farm receipts in 1938 as compared to 30 percent in 1939 and 26 percent in 1940. Nineteen percent of the farm receipts came from tomatoes in 1938 as compared to 18 percent in 1940. The percent of receipts from peas decreased consistently from 1938 to 1940. Receipts from beans constituted 5 percent of the total farm receipts in 1938, 4 percent in 1939, and 8 percent in 1940. Receipts from cotton decreased from 20 percent of the total in 1938 to 12 percent in 1940. Nine percent of the farm receipts came from livestock in 1938, 10 percent in 1939, and 12 percent in 1940. Receipts from miscellaneous items, which include government payments and increases in inventory, accounted for 5 percent of the farm receipts in 1938, 6 percent in 1939, and 9 percent in 1940. The foregoing discussion indicates that cabbage, beans, livestock and miscellaneous items are increasing in importance while tomatoes, cotton, and peas are decreasing in importance as sources of farm receipts.

Farm Expenses

Expenses per farm were $1,702 in 1938, $1,467 in 1939, $1,441 in 1940, and averaged $1,537 (Table 5). Labor and fertilizer were by far the most important items of expense, constituting 64 percent of the total expenses in 1938, 62 percent in 1939, 55 percent in 1940, and averaging 61 percent for the three years. During the same period decreases in inventory accounted for 10 percent of the farm expenses, containers 7 percent, seed 5 percent, truck expense 4 percent, taxes 3 percent and feed and insurance 2 percent each. The percent of farm expenses due to labor decreased from 40 percent in 1938 to 31 percent in 1939, and to 29 percent in 1940. From 1938 to 1940 farm expenses decreased $261 per farm, and during the same period the amount spent for labor decreased $276 per farm. This indicates that the farmers realize that one of the best ways to increase the farm income is to cut down on expenses. Since labor is the largest item of expense, it is logical to assume that farmers would begin here in cutting down expenses. However, this did not have the desired effect in 1939 and 1940, because the farm receipts decreased as much or more than did the farm expenses.

Table 5. Farm Expenses, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average expense	Percent	Average expense	Percent	Average expense	Percent	Average expense	Percent
Labor[1]	$ 687	40.3	$ 461	31.4	$ 411	28.5	$ 520	33.8
Fertilizer	409	24.0	453	30.9	376	26.1	413	26.9
Decrease in inventory	147	8.7	165	11.3	135	9.4	149	9.7
Containers	103	6.1	126	8.6	78	5.4	102	6.6
Seed	69	4.1	54	3.7	83	5.8	69	4.5
Truck expense	45	2.6	41	2.8	78	5.4	55	3.6
Taxes	66	3.9	30	2.0	39	2.7	45	2.9
Feed	13	.8	29	2.0	44	3.1	29	1.9
Insurance	30	1.7	28	1.9	26	1.8	28	1.8
Ginning	36	2.1	15	1.0	13	.9	21	1.4
Twine	17	1.0	15	1.0	16	1.1	16	1.0
Interest	10	.6	6	.4	8	.5	8	.5
Poison	9	.5	6	.4	7	.5	7	.5
Miscellaneous	61	3.6	38	2.6	127	8.8	75	4.9
Total	$1,702	100.0	$1,467	100.0	$1,441	100.0	$1,537	100.0

[1]Includes cost of cropper labor and unpaid family labor.

Farm Privileges

The farm privileges per farm amounted to $305 in 1938, $299 in 1939, $284 in 1940, and averaged $296 for the three years (Table 6). Each family consumed an average of 574 gallons of milk per year, 542 pounds of pork, 122 dozen eggs, 10 cords of wood and 37 head of poultry. Milk contributed more to the farm privileges than any other item. Milk accounted for 23 percent of the farm privileges, the garden and orchard 20 percent, pork 19 percent, miscellaneous crops 17 percent, eggs and fuel 8 percent each, and poultry 5 percent.

Table 6. Value of Farm Privileges, 80 Farms, Copiah County, Mississippi, 1938-1940

	Average per farm											
	1938			1939			1940			Average		
Item	Quantity	Value	Percent	Quantity	Value	Percent	Quantity	Value	Percent	Quantity	Value	Percent
Milk (gal)	560	$ 67	22.0	555	$ 61	20.4	606	$ 72	25.4	574	$ 67	22.6
Garden and orchard		57	18.7		56	18.7		61	21.5		58	19.6
Meat (pork) (lbs.)	533	59	19.2	520	65	21.7	572	46	16.2	542	57	19.3
Misc. crops[1]		53	17.4		57	19.1		41	14.4		50	16.9
Eggs (doz.)	138	28	9.1	110	22	7.4	118	23	8.1	122	24	8.1
Fuel (cords)	11	21	7.0	10	21	7.0	10	31	10.9	10	24	8.1
Poultry (hd.)	50	20	6.6	39	17	5.7	22	10	3.5	37	16	5.4
Total		$305	100.0		$299	100.0		$284	100.0		$296	100.0

[1]Includes corn, sweetpotatoes, Irish potatoes, peanuts and syrup.

Since the value of the products furnished the family by the farm averaged $296 per farm, it is an important factor to be considered in analyzing the farm business. It is interesting to note that the farm privileges actually exceeded the farm income each year. The farm privileges exceeded the farm income $57 in 1938, $78 in 1939, and $165 in 1940.

Profits

There are several measures of farm profits, of which labor income is the most commonly used. Labor income is the amount left at the end of the year for the farmer's labor and management after all expenses, and 4 percent interest on the average investment have been deducted. The labor income per farm was $50 in 1938, $54 in 1939, minus $55 in 1940, and averaged $16 for the three years (Table 7.)

Table 7. Summary of Farm Business, 80 Farms, Copiah County, Mississippi, 1938-1940

	Average per farm			
Item	1938	1939	1940	Average
Farm receipts	$1,950	$1,688	$1,560	$1,733
Farm expenses	1,702	1,467	1,441	1,537
Farm income	248	221	119	196
Interest on investment @ 4%	198	167	174	180
Labor income	50	54	— 55	16
Farm privileges	305	299	284	296
Labor earnings	355	353	229	312
Returned to capital	170	143	— 3	103
Percent returned to capital	3.4	3.4	— .1	2.4

The farm privileges were about the same for each year studied. Labor earnings averaged $355 per farm in 1938, $353 in 1939, and $229 in 1940. The average percent returned to capital was 2.4 percent, ranging from 3.4 percent in 1938 and 1939 to minus .1 percent in 1940.

Table 8. Variations in Labor Income, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940	
Labor income	Number of farms	Average labor income	Number of farms	Average labor income	Number of farms	Average labor income
Less than —$1000	2	—$1427	2	—$1433	2	—$1339
—$1000 to — 750	1	— 754	3	— 922	1	— 851
— 750 to — 500	3	— 610	2	— 539	4	— 624
— 500 to — 250	13	— 390	9	— 326	13	— 349
— 250 to 0	24	— 116	19	— 104	26	— 141
0 to 250	21	123	21	106	23	94
250 to 500	5	333	14	316	6	355
500 to 750	4	576	4	638	2	676
750 to 1000	1	865	3	853	0	—
1000 or more	6	1643	3	1397	3	1385
Total or average	80	$ 50	80	$ 54	80	$ 55

The labor income per farm varied from minus $1,554 to $2,945 in 1938, from minus $1,842 to $1,889 in 1939, and from minus $1,446 to $1,878 in 1940. The majority of the farms had a labor income within the range of minus $250 to $250; 45 of the 80 farms were in this group in 1938, 40 in 1939, and 49 in 1940 (Table 8). Forty-three farms had a minus labor income in 1938, 35 in 1939, and 46 in 1940. Only 6 farms in 1938 and 3 farms each in 1939 and in 1940 had a labor income of more than $1,000. Only the most efficient farmers were able to return a plus labor income, due to the fact that the three years studied were extremely unfavorable for the production and sale of truck crops. The period was characterized by low yields and low prices, which in some cases were the result of low quality products.

FACTORS AFFECTING PROFITS

Size of Business

The size of farm business may be measured by several methods, such as acres of crops, capital invested, days of productive work, man equivalent, productive animal units and number of workstock. For the purpose of this study, however, acres of crops and capital invested will be used as measures of size.

There was no consistent relationship between size of business as measured by acres of crops and labor income, during the period studied. In 1938 the largest farms had the highest labor income; in 1939 the medium size farms, and in 1940 the smallest farms. In 1938, the labor income increased as the acres of crops increased, whereas in 1940 the labor income decreased as the acres of crops increased. In 1939 the medium size farms had the highest labor income, and the largest farms had the lowest (Table 9).

Table 9. Relation of Size of Business as Measured by Acres of Crops to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Acres of crops	Number of farms	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
					1938					
Less than 33	28	23	$1,917	2.3	64	17	8	98	104	$ 0
33-65	26	44	3,290	2.6	56	24	11	99	98	43
66 or more	26	124	9,879	2.6	59	21	8	101	98	110
Total or average	80	62	4,950	2.5	59	21	9	100	100	50
					1939					
Less than 29	27	21	1,907	2.7	69	12	12	100	98	41
29-59	27	41	3,307	2.3	68	11	10	105	104	200
60 or more	26	96	7,503	2.6	69	11	8	95	98	— 84
Total or average	80	52	4,198	2.5	69	11	10	100	100	54
					1940					
Less than 25	27	19	1,963	3.4	59	12	17	99	99	— 3
25-53	28	37	3,805	2.8	58	13	11	101	101	— 33
54 or more	25	101	7,596	2.2	71	11	7	99	99	—137
Total or average	80	51	4,369	2.8	62	12	12	100	100	— 55

In each of the three years the capital invested increased as the acres of crops increased. Capital efficiency was greatest on the small farms in 1938, on the medium size farms in 1939, and on the large farms in 1940. There was no consistent relation between acres of crops and production efficiency or marketing efficiency. Production efficiency was highest on the large farms in 1938, and on the medium size farms in 1939 and 1940. Marketing efficiency was highest on the small farms in 1938 and on the medium size farms in 1939 and 1940.

When size of business was measured by average capital, it was found that there was no consistent relationship between labor income and size of business. In 1938 and 1939 the medium size farms had the highest labor income, whereas in 1940 the small farms had the highest labor income; the small farms in 1938 and the large farms in 1939 and 1940 had the lowest labor income (Table 10). Acres in crops increased in each instance as capital invested increased. In each of the years the highest capital efficiency was found on the farms with the lowest capital investment. The highest production efficiency was found on the farms with the highest capital investment in 1938, and on the farms with a medium amount of capital in 1939 and 1940. Marketing efficiency was highest on the medium size farms in 1938 and 1939, and on small farms in 1940.

It is evident that during the past three years, size of business has not been one of the most important factors in determining profits. In general, the large farms have proved the least profitable. One would expect this, since large farms have a greater chance for loss in bad years.

Table 10. Relation of Size of Business as Measured by Average Capital to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Average capital	Number of farms	Average capital	Acres of crops	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
					1938					
Less than $2500	27	$1,152	26	1.9	63	22	5	92	99	—$34
2500-4999	27	3,765	45	2.9	57	16	13	101	103	102
5000 or more	26	10,123	118	2.8	58	23	7	107	98	83
Total or average	80	$4,950	62	2.5	59	21	9	100	100	$50
					1939					
Less than 2550	27	1,367	24	1.8	74	11	7	101	97	61
2550-4499	26	3,570	41	2.8	65	11	14	102	105	169
4500 or more	27	7,635	90	2.8	67	12	9	98	98	—63
Total or average	80	$4,198	52	2.5	69	11	10	100	100	$54
					1940					
Less than 2500	26	1,388	22	2.2	65	12	12	96	103	27
2500-4499	28	3,425	39	3.1	59	13	14	102	98	8
4500 or more	26	8,364	93	3.1	62	12	10	99	97	—206
Total or average	80	$4,369	51	2.8	62	12	12	100	100	—$55

Production Efficiency

Production efficiency is one of the chief factors to be considered in accounting for high incomes on some farms and low incomes on others. Production efficiency of crops was measured by a factor known as crop index, which is the yields of the major crops on each farm expressed as a percentage of the average yield of the area.

Table 11. Relation of Crop Index to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Crop index	Number of farms	Crop index	Price index	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Labor income
					1938					
Less than 88	27	77	100	48	$3,330	2.8	58	19	8	—$123
88-103	26	98	101	58	4,595	2.3	61	19	12	105
104 or more	27	124	99	82	6,909	2.4	59	23	7	169
Total or average	80	100	100	62	$4,950	2.5	59	21	9	$50
					1939					
Less than 91	27	78	93	63	4,819	2.8	69	9	13	— 174
91-110	28	97	104	47	3,647	2.7	67	13	9	53
111 or more	25	127	104	45	4,147	2.0	70	12	8	302
Total or average	80	100	100	52	$4,198	2.5	69	11	10	$54
					1940					
Less than 90	27	76	94	49	3,888	2.9	55	12	16	— 195
90-105	25	99	104	63	5,757	3.2	64	13	12	— 70
106 or more	28	123	101	42	3,587	2.3	67	12	9	94
Total or average	80	100	100	51	$4,369	2.8	62	12	12	— $55

During each of the three years studied, labor income increased as crop indices increased. Each year the farms with the highest production efficiency had the highest labor income, and the farms with the lowest production efficiency had the lowest labor income (Table 11). The farms with highest production efficiency had $292 more labor income per farm than did the farms with the poorest production efficiency in 1938, $476 more in 1939, and $289 more in 1940. There was no consistent relationship between production efficiency and marketing efficiency, capital efficiency, or size of business during the three years studied.

Production efficiency seemed to be one of the most important factors in determining farm incomes, since in each instance as production efficiency increased the labor income increased. This was true in only one other case; namely, capital efficiency.

Marketing Efficiency

Marketing or price efficiency was measured by a factor known as price index, which is the ratio of the prices received by each farmer to the average price received by all farmers studied. The price index is an average of the prices of commodities sold, weighted by the value of the products sold. The price index reflects to some extent the farmers' marketing ability, and also the quality of the products sold.

Table 12. Relation of Price Index to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Price index	Number of farms	Price index	Crop index	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Labor income
					1938					
Less than 97	27	85	98	59	$4,251	2.7	65	18	6	—$232
97-104	26	99	107	76	6,188	2.4	45	30	14	250
105 or more	27	116	95	54	4,456	2.3	67	14	6	139
Total or average	80	100	100	62	$4,950	2.5	59	21	9	$50
					1939					
Less than 84	26	78	93	47	$3,686	3.1	66	13	9	—$229
84-100	28	94	103	60	4,881	2.4	67	12	11	81
101 or more	26	125	104	48	3,976	2.0	74	9	9	308
Total or average	80	100	100	52	$4,198	2.5	69	11	10	$54
					1940					
Less than 91	28	87	95	50	$4,087	3.1	60	12	12	—$238
91-99	29	98	98	50	4,560	3.0	56	12	14	— 66
100 or more	23	118	107	52	4,467	2.0	72	10	8	181
Total or average	80	100	100	51	$4,369	2.8	62	12	12	— $55

In each of the years studied, the farms with lowest marketing efficiency had the lowest labor income and in all cases except one the farms with the highest marketing efficiency had the highest labor income (Table 12). The farms with the highest marketing efficiency had $371 more labor income per farm than did the farms with the lowest marketing efficiency in 1938, $537 more in 1939, and $419 more in 1940. In 1939 and 1940, production efficiency increased as marketing efficiency increased, but this was not true in 1938. When size of business is measured by average capital, the medium size farms had highest marketing efficiency during each of the years studied. There was a definite relationship between marketing efficiency and capital efficiency (farm capital turnover). As marketing efficiency increased capital efficiency increased each year.

Capital Efficiency

Capital efficiency was measured by the factor, farm capital turnover, which is the number of years required for farm receipts to equal the farm capital. It is obtained by dividing the farm receipts into the farm capital. There was a direct relationship between capital efficiency and labor income, in all cases as capital efficiency increased, the labor income increased (Table 13). The farms with the highest capital efficiency had $399 more labor income per farm than did the farms with the lowest capital efficiency in 1938, $337 more in 1939, and $375 more in 1940.

Table 13. Relation of Capital Efficiency (Farm Capital Turn-over) to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Farm capital turnover	Number of farms	Farm capital turnover	Average capital	Acres of crops	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
					1938					
Less than 2.0	27	1.2	$2,401	47	64	16	10	97	103	$ 256
2.0-3.1	26	2.4	6,973	87	61	20	9	102	100	36
3.2 or more	27	3.9	5,549	55	53	25	7	100	97	—143
Total or average	80	2.5	$4,950	62	59	21	9	100	100	$ 50
					1939					
Less than 2.0	27	1.2	$2,748	47	76	8	9	105	110	$ 239
2.0-3.0	27	2.4	5,062	63	70	11	8	99	98	16
3.1 or more	26	4.0	4,808	45	61	13	13	95	92	— 98
Total or average	80	2.5	$4,198	52	69	11	10	100	100	$ 54
					1940					
Less than 2.2	27	1.5	$3,658	60	69	10	11	106	105	$ 130
2.2-4.3	26	2.8	4,885	58	65	12	12	97	99	— 50
4.4 or more	27	4.8	4,573	35	51	14	14	96	95	—245
Total or average	80	2.8	$4,369	51	62	12	12	100	100	—$55

In each of the years studied, the farms with the highest capital efficiency had the smallest amount of capital invested. Marketing efficiency seemed to be a definite factor affecting capital efficiency, increasing consistently with increases in capital efficiency each year. Production efficiency decreased as capital efficiency increased in 1939 and 1940, but did not in 1938.

Balance of Farm Business

Balance deals with the number and adjustments of enterprises on the farms. Balance of farm business may be measured by several methods; but for this study only percent of cash receipts from important sources is used.

There was no consistent relationship between percent of cash receipts from truck crops and labor income during the period studied. Labor income was highest on farms with the lowest percent of cash receipts from truck crops in 1938 and 1940, and on the farms with the medium percent of cash receipts from truck crops in 1939 (Table 14). During each year the farms with receipts from truck crops had neither the highest or lowest labor income, but the farms with the highest percent of cash were found to have the smallest capital investment and the highest capital efficiency. The percent of cash receipts from truck crops did not seem to have much effect on production and marketing efficiency.

Labor income was highest on farms with the lowest percent of cash receipts from cotton in 1938 and 1939, and on the farms with the highest percent of cash receipts from cotton in 1940 (Table 15). Labor income was lowest each year on the farms with the medium percent of cash receipts from cotton. There was no relationship between size of business or capital efficiency and percent of cash receipts from cotton. Production efficiency was highest on the farms with the highest percent of cash receipts from cotton in 1939 and 1940, and on the farms with a medium percent of cash receipts from cotton in 1938. Marketing efficiency increased as the percent of cash receipts from cotton increased, except in 1940 when it remained constant.

Table 14. Relation of Percent of Cash Receipts from Truck Crops to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Percent of cash receipts from truck crops	Number of farms	Average per farm								
		Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
						1938				
Less than 50	27	34	34	15	64	$5,451	2.7	96	102	$ 150
50-70	27	61	20	8	60	4,908	2.6	107	96	—54
71 or more	26	84	6	4	63	4,472	2.1	97	103	53
Total or average	80	59	21	9	62	$4,950	2.5	100	100	$ 50
						1939				
Less than 64	28	50	17	19	51	$4,580	2.8	100	96	5
64-76	25	71	12	7	53	4,822	2.8	106	103	147
77 or more	27	86	4	5	52	3,226	1.8	94	102	19
Total or average	80	69	11	10	52	$4,198	2.5	100	100	$ 54
						1940				
Less than 50	26	33	19	22	35	$4,273	3.6	97	96	—$21
50-66	24	63	12	10	59	4,749	2.8	95	98	— 82
67 or more	30	86	6	4	57	4,146	2.2	105	104	— 64
Total or average	80	62	12	12	51	$4,369	2.8	100	100	—$55

Table 15. Relation of Percent of Cash Receipts from Cotton to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Percent of cash receipts from cotton	Number of farms	Average per farm								
		Percent of cash receipts from cotton	Percent of cash receipts from truck crops	Percent of cash receipts from livestock	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
						1938				
Less than 11	26	3	78	10	54	$3,702	2.1	94	102	$ 80
11-26	26	18	61	8	63	4,981	2.6	104	101	14
27 or more	28	39	40	9	70	6,079	2.7	101	97	55
Total or average	80	21	59	9	62	$4,950	2.5	100	100	$ 50
						1939				
Less than 5	26	1	79	13	44	$3,288	2.3	96	103	$184
5-16	27	10	72	8	67	4,731	2.2	95	100	— 30
17 or more	27	23	56	9	44	4,543	3.0	109	97	13
Total or average	80	11	69	10	52	$4,198	2.5	100	100	$ 54
						1940				
Less than 7	26	2	72	15	55	$4,446	2.7	99	100	—$21
7-16	27	10	67	11	56	4,596	2.7	96	100	—239
17 or more	27	24	47	11	41	4,058	3.1	103	100	95
Total or average	80	12	62	12	51	$4,369	2.8	100	100	—$55

When balance was measured by the percentage of cash receipts from livestock, it was found that in each year the farms with the highest percentage of cash receipts from livestock had the highest labor income (Table 16). Labor income was lowest on farms with a medium percent of cash receipts from livestock in 1938 and 1940, and on the farms with the smallest percent of cash receipts from livestock in 1939. The percentage of cash receipts from livestock did not appear to have much effect on size of business, capital efficiency, production efficiency, or marketing efficiency. In each case as the percent of cash receipts from livestock increased, the percent of cash receipts from truck crops decreased.

Table 16. Relation of Percent of Cash Receipts from Livestock to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Percent of cash receipts from livestock	Average per farm									
	Number of farms	Percent of cash receipts from livestock	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
1938										
Less than 3	26	1	69	20	52	$4,282	2.6	102	98	—$73
3-8	30	5	62	20	66	4,886	2.6	101	100	—160
9 or more	24	22	45	21	70	5,751	2.4	95	102	445
Total or average	80	9	59	21	62	$4,950	2.5	100	100	$50
1939										
Less than 4	25	1	77	13	47	$3,431	2.2	103	101	—$79
4-12	28	7	74	9	67	5,163	2.3	102	102	28
13 or more	27	22	56	11	41	2,910	3.0	95	97	204
Total or average	80	10	69	11	52	$4,198	2.5	100	100	$54
1940										
Less than 4	25	1	72	14	53	$3,445	2.3	103	98	—$73
4-11	28	6	70	12	59	4,972	2.7	104	101	— 84
12 or more	27	28	43	11	41	4,591	3.4	91	99	— 9
Total or average	80	12	62	12	51	$4,369	2.8	100	100	—$55

The foregoing discussion indicates that, in general, the farms with a high percent of cash receipts from livestock and a smaller percent of cash receipts from truck crop and cotton were more profitable.

Comparison of High and Low Profit Farms

The 20 most profitable farms and the 20 least profitable farms were compared with respect to several of the factors for success (Table 17). The 20 most profitable farms had an average labor income of $778 in 1938, $634 in 1939, and $456 in 1940, compared to minus $538 in 1938, minus $520 in 1939, and minus $528 in 1940, for the least profitable farms. In 1938 and 1939 the least profitable and most profitable farms were approximately the same size, but in 1940 the least profitable farms were much larger. In each of the years studied the most profitable farms used their capital more efficiently, had higher crop yields, sold products for higher prices, had a smaller percent of cash receipts from truck crops and a higher percent of cash receipts from cotton and livestock than did the least profitable farms.

When the three years were averaged, it was found that the 20 most profitable farms had an average of 59 acres of crops and $4911 capital invested. This compares with 71 acres of crops and $5816 capital invested for the 20 least profitable farms. It required an average of 1.7 years for the receipts to equal the farm capital on the 20 most profitable farms, as compared with 3.3

Figure 5. A high-yielding field of cabbage—the best paying truck crop during the years studied

years on the 20 least profitable farms. The 20 most profitable farms received 58 percent of the cash receipts from truck crops, 15 percent from cotton, and 16 percent from livestock; whereas the 20 least profitable farms received 68 percent of cash receipts from truck crops, 13 percent from cotton and 7 percent from livestock. The crop index was 10 percent above average on the 20 most profitable farms, and 11 percent below average on the 20 least profitable farms. The price index was 17 percent higher on the most profitable farms than on the 20 least profitable farms.

Table 17. Comparison of Certain Factors on Farms of Varying Success, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms
Acres of crops	79	78	54	54	44	80	59	71
Average capital (dollars)	6,144	5,729	4,682	4,682	3,907	7,037	4,911	5,816
Farm capital turnover	1.8	3.3	1.7	3.1	1.6	3.5	1.7	3.3
Percent of cash receipts from truck crops	50	63	67	73	58	68	58	68
Percent of cash receipts from cotton	21	18	10	10	14	10	15	13
Percent of cash receipts from livestock	18	5	14	6	16	10	16	7
Crop index	99	92	114	88	116	88	110	89
Price index	103	93	117	84	106	99	109	92
Labor income (dollars)	778	—538	634	—520	456	—528	623	—529

The foregoing discussion indicates that the most profitable farms were smaller in size, had higher crop yields, received higher prices and used capital more efficiently than the least profitable farms. The most profitable farms found it necessary to have a smaller percent of their cash receipts come from truck crops, and a larger percent from cotton and livestock than did the least profitable farms.

COMMODITY STUDIES

Cabbage

Cabbage ranked first in total acreage and in source of income among truck crops grown on the farms during the period investigated. Most of the cabbage produced in Copiah County are graded and packed at shippers' packing sheds or loading platforms on railroad sidings by experienced commercial packers. The western crate, holding from 85 to 100 pounds, and the pony crates are used, the former being more popular. Most of the cabbage are sold to local buyers for cash, f. o. b. shipping point. There are a few consignment and joint account sales. The shipments of cabbage from Copiah County increased from 1,047 cars in 1931 to 2,111 in 1939 but decreased to 1,253 in 1940. The shipment of 1,253 cars in 1940 was the lowest since 1923, when 706 cars were shipped (Table 25). Chicago, Detroit, St. Louis, and Pittsburg are the principal markets, while the larger cities in the North Central, Middle Atlantic, and North Atlantic States share in the car-lot movement. Considerable quantities are shipped to Canada during some years. None of the cabbage is used for canning purposes.

Table 18. Average Inputs,[1] Costs, and Returns per Acre of Cabbage, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,743	23.63	1,671	25.37	1,572	21.48	1,666	23.52
Man labor, hrs.	108	10.80	123	12.30	113	11.30	115	11.46
Rent		3.57		3.84		3.68		3.69
Crates		—	32	5.61	16	2.77	16	2.75
Horse labor, hrs.	50	2.50	47	2.35	45	2.25	47	2.37
Truck expense		2.02		1.95		2.55		2.17
Seed, ounces	8	1.00	8	.63	13	4.01[2]	10	1.84[2]
Coldframe, equipment		1.04		1.02		1.07		1.04
Straw		1.00		1.00		1.00		1.00
Equipment expense		.85		.75		.85		.82
Interest		.75		.69		.75		.73
Poison		.36		.27		.38		.34
Total cost		47.52		55.78		52.09		51.73
Value of cabbage per acre		43.70		65.15		53.24		53.89
Cost of cabbage per acre		47.52		55.78		52.09		51.73
Net returns per acre		— 3.82		9.37		1.15		2.16
Average price per ton		7.64		12.41		12.80		10.63
Average cost per ton		8.31		10.62		12.52		10.20
Net returns per ton		— .67		1.79		.28		.43
Returns to labor per acre[3]		6.98		21.67		12.45		13.62
Returns per day of labor[4]		.65		1.76		1.10		1.18
No. of farms growing		80		78		73		77
Total acres of cabbage		652		624		597		624
Yields in tons per acre		5.72		5.25		4.16		5.07

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[1] The term "inputs" refers to the amounts of the production elements that are used in turning out a product.

[2] Includes cost of some plants.

[3] Net returns per acre plus the amount charged for man labor.

[4] Returns to labor divided by days of work. Ten hours is considered a day of work.

The first operation in preparation for the cabbage crop is the seeding of the cold frames in October. The first field operation consists of cutting stalks in December. The common practice is to subsoil with two furrows, put out fertilizer by hand, then bed, using four furrows with a turning plow. Harrowing with a one-horse implement is the next operation. The bed is then opened with a turning plow with moldboard removed, reharrowed, and the plants set out by hand. The seed bed is prepared and the plants set out in January.

The cabbage is usually given three complete cultivations consisting of from three to six furrows to the row per cultivation. The side dressing of a nitrate is applied during the second cultivation, and the last of the three usual cultivations occurs in March. Approximately 85 percent of the cabbage is harvested in May (Table 26).

An acre of cabbage required an average of 1,666 pounds of fertilizer, 115 man hours, 47 horse hours, 16 crates, and 10 ounces of seed for the three years studied (Table 18).

The average cost of producing an acre of cabbage was $51.73, and ranged from $47.52 in 1938 to $55.78 in 1939. Fertilizer was the most important item of expense. During the period studied fertilizer represented 46 percent of the total cost of production, man labor 22 percent, rent 7 percent and crates and horse labor 5 percent each.

The gross value of cabbage per acre was $43.70 in 1938, $65.15 in 1939, $53.24 in 1940, and averaged $53.89. The net returns per acre averaged $2.16 and ranged from minus $3.82 in 1938 to $9.37 in 1939. The average price received per ton of cabbage was $10.63; the average cost per ton was $10.20, leaving a net return of $0.43 per ton. The returns to labor per acre averaged $13.62 and ranged from $6.98 in 1938 to $21.67 in 1939. The returns per day of labor averaged $0.65 in 1938, $1.76 in 1939, $1.10 in 1940, and $1.18 for the three years.

Tomatoes

Tomatoes ranked second to cabbage in acreage and receipts during the three years studied. Carlot shipments of tomatoes from Copiah County decreased from 1,935 cars in 1931 to 1,531 cars in 1939, and to 751 cars in 1940. The shipment of 751 cars in 1940 was the lowest in over a decade, and amounted to less than one-half of the 1939 shipments. The price of 75 cents per bushel in 1938, 60 cents in 1939, and 65 cents in 1940* was far below the average price of $1.10 received by farmers during the past 10 years (1931-1940) (Table 27).

The first operation in the preparation for the tomato crop is the cutting of corn stalks in December. The hotbeds are seeded in January, and the tomato plants transplanted to cold frames in February. The preparation of the seed bed is the same as for cabbage, but is done in March. The tomatoes are usually given three to four complete cultivations consisting of from three to six furrows to the row per cultivation.

They are usually side dressed with a nitrate fertilizer during the second cultivation. Tomatoes are staked and tied in April, pruned three or four times in April and May, and topped following the last cultivation which occurs in May. About 90 percent of the tomatoes are harvested in June, most of the other 10 percent is harvested in late May, while a few are harvested in early July (Table 26).

During the three years studied, an acre of tomatoes required an average of 1,537 pounds of fertilizer, 192 man hours of work, 5,000 sticks, 45 horse hours of work, and 5 pounds of jute (Table 19). The average cost of producing an acre of tomatoes was $63.32, ranging from $61.55 in 1938 to $64.83 in 1939. Fertilizer represented 34 percent of the total cost of production, man labor 30 percent, rent and sticks 6 percent each, and lugs 4 percent.

The sales of tomatoes per acre amounted to $44.57 in 1938, $49.03 in 1939, $56.45 in 1940 and averaged $49.06. The net returns per acre averaged minus $14.26 and ranged from minus $7.71 in 1940 to minus $16.98 in 1938. The average price received for tomatoes was $0.50; the average cost was $0.64 per bushel, leaving a net return of minus $0.14 per bushel. The returns to labor per acre were $4.92, ranging from $1.92 in 1938 to $11.89 in 1940. The returns per day of labor were $0.10 in 1938, $0.18 in 1939, $0.61 in 1940, and averaged $0.26 for the three years.

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*The prices in this study were for unpacked tomatoes and do not agree with the census prices which were for packed tomatoes.

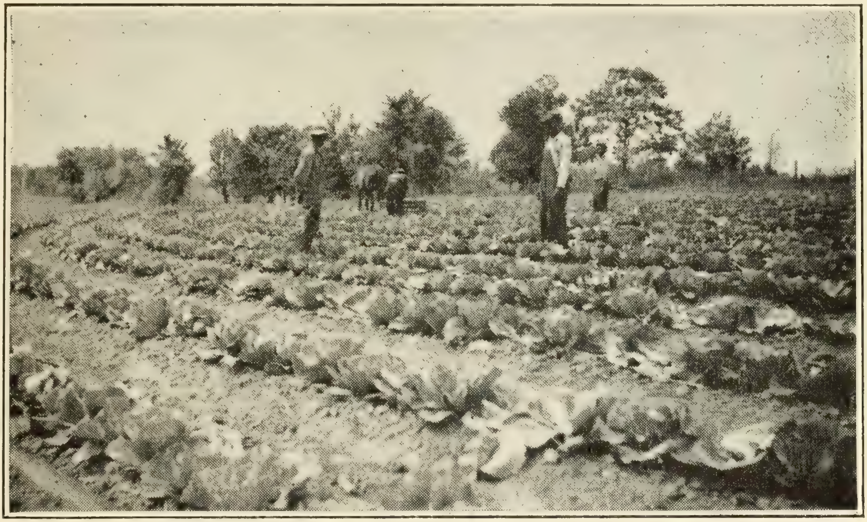

Figure 6. Harvesting cabbage. Cabbage are cut by hand and sledded out of fields

Table 19. Average Inputs, Cost, and Returns Per Acre of Tomatoes, Copiah County, Mississippi, 1938-1940

Item	1938		1939		1940		Average	
	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,628	21.80	1,484	22.18	1,462	19.93	1,537	21.46
Man labor, hrs.	189	18.90	192	19.20	196	19.60	192	19.18
Sticks	5,000	3.75	5,000	3.68	5,000	3.79	5,000	3.74
Rent		3.57		3.84		3.68		3.69
Lugs	—	—	42	4.65	38	3.84	24	2.54
Hotbed, equipment		2.50		2.45		2.54		2.49
Horse labor, hrs.	50	2.50	40	2.00	44	2.20	45	2.25
Truck expense		1.69		1.21		1.87		1.57
Coldframe, equipment		1.55		1.52		1.60		1.55
Jute (twine), lbs.	5	.96	5	1.04	6	1.24	5	1.06
Straw		1.00		1.00		1.00		1.00
Seed, ounces	2	1.25	1	46	1	.88[1]	1	.89
Equipment expense		.85		.64		.80		.77
Interest		.75		.59		.70		.68
Poison		.48		.37		.49		.45
Total cost		61.55		64.83		64.16		63.32
Value of tomatoes per a.		44.57		49.03		56.45		49.06
Cost of tomatoes per a.		61.55		64.83		64.16		63.32
Net returns per acre		—16.98		—15.80		— 7.71		—14.26
Average price per bushel		.39		.58		.58		.50
Average cost per bushel		.54		.76		.66		.64
Net returns per bushel		— .15		— .18		— .08		— .14
Returns to labor per a.		1.92		3.40		11.89		4.92
Returns per day of labor		.10		.18		.61		.26
No. of farms growing		79		80		71		77
Total acres of tomatoes		649		538		397		528
Yield in bu. per acre		113		85		97		99

[1] Includes cost of some plants.

Peas

Peas ranked third in importance among truck crops in Copiah County. An average of 142 cars of peas was shipped annually for the period 1931-1940. The shipment of 20 cars in 1940 was the lowest in over a decade (Table 25). The average farm price of peas for the period 1931-1940 was $1.03 per bushel. The price of peas was above average in 1938, but below average for the other two years (Table 27).

The first operation in the cultivation of peas is the cutting of stalks in December with a stalk cutter. Rows are then laid off with either a middle buster or a turning plow, and the fertilizer put out and covered with four furrows. The above-listed operations take place in early December. The beds are harrowed and planted about the first of February. The first cultivation takes place around March 1, consisting of scratching with a scratcher and running out the middles with a middle buster. The peas are staked and tied following the first cultivation. The second and final cultivation occurs about a week later, consisting of scratching with a scratcher and running around the rows with a sweep and plow, side dressing with a nitrate and covering with either a middle buster (one furrow) or a turning plow (two furrows). The peas are harvested in April and May.

Table 20. Average Inputs, Cost and Returns per Acre of Peas, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,382	18.47	1,344	20.11	1,376	19.11	1,369	19.18
Man labor, hrs.	122	12.20	145	14.50	120	12.00	128	12.85
Seed, lbs.	104	11.34	93	10.50	92	10.07	97	10.68
Hampers	72	7.20	78	8.58	56	6.16	69	7.30
Rent		3.57		3.84		3.68		3.69
Jute (twine), lbs.	16	3.27	17	3.57	19	4.23	17	3.66
Sticks	3,000	2.25	3,000	2.21	3,000	2.27	3,000	2.24
Horse labor, hrs.	33	1.65	32	1.60	30	1.50	32	1.59
Truck expense		1.27		1.39		1.72		1.45
Equipment expense		.56		.51		.57		.55
Interest		.50		.47		.50		.49
Poison		.35		.26		.35		.32
Total cost		62.63		67.54		62.16		64.00
Value of peas per acre		82.08		51.90		38.66		59.16
Cost of peas per acre		62.63		67.54		62.16		64.00
Net returns per acre		19.45		—15.64		—23.50		— 4.84
Average price per bu.		1.14		0.67		0.69		0.86
Average cost per bu.		.87		.87		1.11		.93
Net returns per bu.		.27		— .20		— .42		— .07
Returns to labor per a.		31.65		— 1.14		—11.50		8.01
Returns per da. of labor		2.59		— .08		— .96		.66
No. of farms growing		55		55		47		52
Total acres of peas		225		183		187		198
Yields in bu. per acre		72		78		56		69

The average of the farms surveyed shows that an acre of peas required 28 man hours of labor, 32 horse hours of labor, 1,369 pounds of fertilizer, 97 pounds of seed, and 17 pounds of jute (Table 20). The average cost of producing an acre of peas was $64.00, of which fertilizer was the most important item. Fertilizer represented 30 percent of the total cost of production; man labor 20 percent, seed 17 percent, hampers 11 percent and rent and jute 6 percent each.

The sales of peas per acre amounted to $82.08 in 1938, $51.90 in 1939, $38.66 in 1940, and averaged $59.16 for the three years. The net returns per acre of peas showed the greatest variation of any of the crops studied. The

Figure 7. Peas ready for harvest

net returns per acre averaged minus $4.84 and ranged from $19.45 in 1938 to minus $23.50 in 1940. The average price received per bushel of peas was $0.86, the average cost was $0.93, leaving a net return of minus $0.07 per bushel. The returns to labor per acre were $8.01, ranging from $31.65 in 1938 to minus $11.50 in 1940. The returns per day of labor were $2.59 in 1938, minus $0.08 in 1939, minus $0.96 in 1940, and averaged $0.66 for the three years.

Beans

Beans ranked fourth among truck crops as a source of cash income in Copiah County. The shipment of 43 cars in 1940 was the lowest since 1933, when only 24 cars were shipped. An average of 147 cars was shipped annually for the period 1931-1940 (Table 25).

In late February, the land for beans is laid off with a middle buster or turning plow; then the fertilizer put out and the land bedded, using four furrows. The land is harrowed, opened, and planted about the middle of March. The first cultivation occurs about April 10, consisting of scratching and running out the middles. The second cultivation occurs about a week later and consists of scratching with a scratcher (a one-horse cultivator) and running around with a sweep. The side dressing is placed in the furrow made by the sweep and covered, using two furrows with a turning plow. This is usually followed a week later by a light cultivation with a sweep or harrow. The beans are harvested in May and June.

An acre of beans required an average of 101 man hours, 33 horse hours, 1,348 pounds of fertilizer, 59 hampers and 50 pounds of seed during the period studied. The average cost of producing an acre of beans was $48.07 and ranged from $44.82 in 1938 to $50.19 in 1940. The average expenditures per acre for fertilizer amounted to 39 percent of the total cost, man labor 21 percent, hampers 13 percent, seed 10 percent, and rent 8 percent (Table 21).

The value of beans per acre was $41.47, ranging from $28.73 in 1939 to $57.98 in 1940. The net returns per acre were minus $6.82 in 1938, minus $21.22 in 1939, $7.79 in 1940, and averaged minus $6.60 for the three years. The average price received for beans was $0.70, the average cost was $0.81, leaving a net return of minus $0.11 per bushel. The returns to labor per acre averaged $3.53 and ranged from minus $10.02 in 1939 to $19.09 in 1940. The returns per day of labor were $0.18 in 1938, minus $0.89 in 1939, $1.69 in 1940, and averaged $0.35 for the three years.

Table 21. Average Inputs, Cost and Returns per Acre of Beans, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,497	20.20	1,279	19.27	1,236	16.99	1,318	18.90
Man labor, hrs.	83	8.30	112	11.20	113	11.30	101	10.13
Hampers	50	5.00	64	7.04	65	7.15	59	6.30
Seed, lbs.	45	4.50	45	4.20	60	6.67	50	5.09
Rent		3.57		3.84		3.68		3.69
Horse labor, hrs.	26	1.30	38	1.90	36	1.80	33	1.64
Truck expense		.88		1.14		1.30		1.09
Equipment expense		.44		.61		.55		.53
Interest		.39		.56		.49		.47
Poison		.24		.19		.26		.23
Total cost		44.82		49.95		50.19		48.07
Value of beans per acre		38.00		28.73		57.98		41.47
Cost of beans per acre		44.82		49.95		50.19		48.07
Net returns per acre		— 6.82		—21.22		7.79		— 6.60
Average price per bu.		.76		.45		.89		.70
Average cost per bu.		.90		.78		.77		— .81
Net returns per bu.		— .14		— .33		— .12		— .11
Returns to labor per acre		1.48		—10.02		19.09		3.53
Returns per da. of labor		.18		— .89		1.69		.35
No. of farms growing		58		58		59		58
Total acres of beans		217		174		180		190
Yield in bu. per acre		50		64		65		59

Cotton

Cotton was grown on almost every farm; but, in general, truck crops were far more important. Cotton was usually neglected for truck crops. In terms of cash receipts and total acres, cotton was the third most important cash crop grown, ranking below cabbage and tomatoes in both respects. On some farms, cotton was grown as a second crop following truck, but this was not the general practice. Corn was the usual crop to follow truck. Deltapine 11 was the most common variety of cotton grown.

The average of the farms surveyed showed that an acre of cotton required 123 man hours, 54 horse hours, 295 pounds of fertilizer, and approximately 1 bushel of seed (Table 22). The average cost of producing an acre of cotton was $29.40, ranging from $29.54 in 1939 to $31.31 in 1938. Man labor was the most important item of expense. Man labor represented 42 percent of the total cost of production, fertilizer 16 percent, rent 12 percent, ginning 10 percent, and horse labor 9 percent.

The sales of cotton and cotton seed per acre amounted to $34.66 and ranged from $39.32 in 1938 to $30.41 in 1940. The net returns per acre amounted to $8.01 in 1938, $1.33 in 1939, $4.39 in 1940, and averaged $5.26 for the three years. The returns to labor per acre were $17.61, ranging from $21.40 in 1938 to $13.23 in 1939. Returns per day of labor amounted to $1.60 in 1938, $1.11 in 1939, $1.40 in 1940, and averaged $1.43 for the three years.

Table 22. Average Inputs, Cost and Returns per Acre of Cotton, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Man labor, hrs.	134	13.40	119	11.90	110	11.00	123	12.35
Fertilizer	320	4.39	344	5.31	205	2.82	295	4.20
Rent		3.57		3.84		3.68		3.67
Ginning		3.51		2.67		2.22		2.94
Horse labor, hrs.	56	2.80	54	2.70	51	2.55	54	2.70
Equipment expense		.95		.86		.96		.93
Truck expense		.85		.81		1.07		.90
Seed, lbs.	33	1.00	29	.66	30	.88	31	.88
Interest		.84		.79		.84		.83
Total cost		31.31		29.54		26.02		29.40
Value of cotton per acre		39.32		30.87		30.41		34.66
Cost of cotton per acre		31.31		29.54		26.02		29.40
Net returns per acre		8.01		1.33		4.39		5.26
Returns to labor per a.		21.40		13.23		15.39		17.61
Returns per day of labor		1.60		1.11		1.40		1.43
No. of farms growing		66		64		65		65
Total acres of cotton		815		460		482		586
Yield in pounds of lint cotton per acre		366		279		272		317

Comparison of the Crops Studied

Several measures may be used to determine the profitableness of a crop. The measures used in this study were: (1) net returns per acre; (2) return to labor per acre; and (3) return per day of labor. Net return per acre is the measure most commonly used and is the amount left after all expenses, both cash and non-cash, have been subtracted from the cash receipts. Returns to labor per acre is the cash receipts minus all expenses except labor, and the return per day of labor is the return to labor per acre divided by the days worked per acre.

Cotton was the most profitable crop and cabbage was the most profitable truck crop grown during the last three years. Cotton averaged a net return of $5.26 per acre, cabbage $2.16 per acre, peas minus $4.84 per acre, beans minus $6.60 per acre, and tomatoes minus $14.26 per acre (Figure 8). Although cotton averaged the highest net returns per acre for the three years, it was exceeded in net returns by some other crop in each of the years. Peas had the highest net returns per acre in 1938, cabbage in 1939, and beans in 1940. Cotton ranked second in each of these years.

Returns to labor per acre is the measure of profit that should probably be used when the farmer uses his own or family labor altogether. It represents what the farmer receives for the work performed in making the crop. Peas and beans in 1939 and peas in 1940 were the only crops for which the farmers failed to receive any compensation for their labor. Peas in 1938, cabbage in 1939, and beans in 1940 had the highest returns to labor per acre. During the three years studied, returns to labor per acre were $17.61 for cotton, $13.62 for cabbage, $8.01 for peas, $4.92 for tomatoes and $3.53 for beans (Figure 9).

Returns to labor per day is the measure of profit that should probably be used where one crop requires considerably more labor than another. One can readily see that if a farmer has a limited acreage he will grow the crops that return the most per acre; but if his labor is limited, he will grow the crop that returns the most per day worked. The highest returns to labor per day were $2.59 for peas in 1938, $1.76 for cabbage in 1939, and $1.69 for beans in 1940 (Figure 10). Cotton was the only crop to have returns to labor per day of over $1.00 in each of the years studied, being $1.60 in 1938, $1.11 in 1939, and

$1.40 in 1940. The average returns to labor per day for the three years studied were: cotton $1.43, cabbage $1.18, peas $0.66, beans $0.35, and tomatoes $0.26.

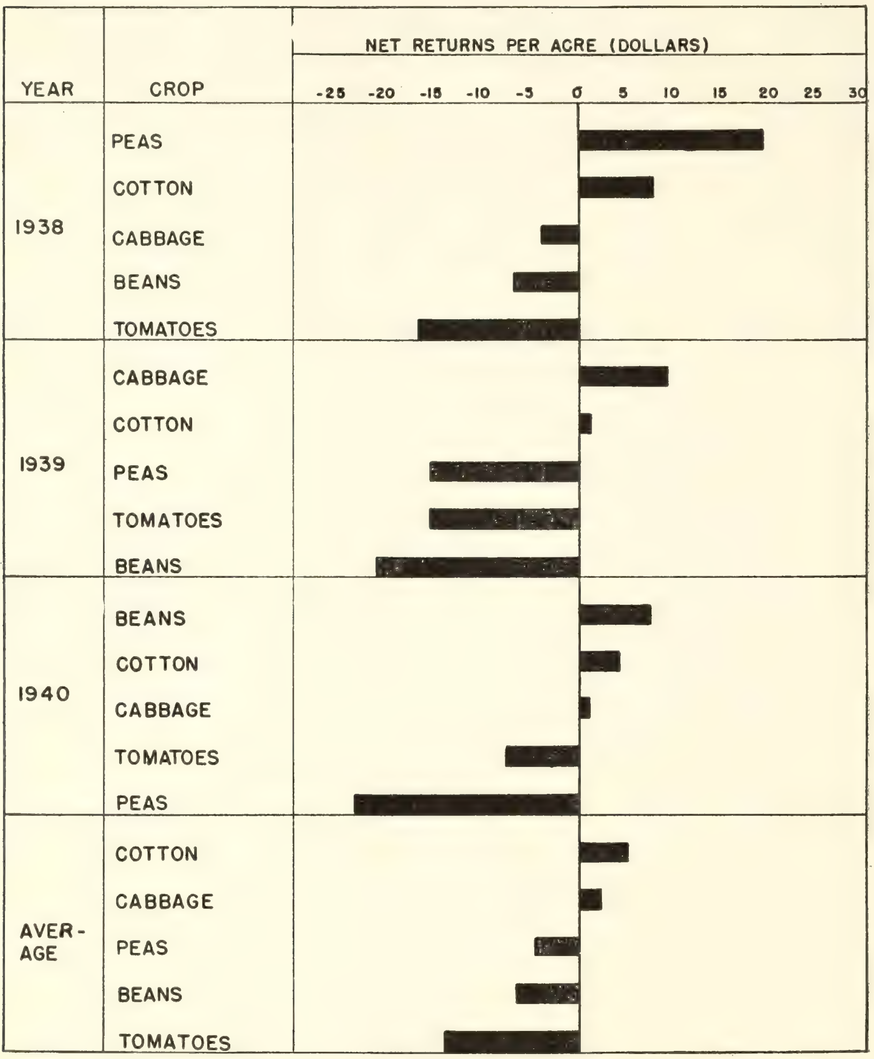

Figure 8. Net returns per acre for important crops, Copiah County, Mississippi, 1938-1940

It is evident that during the period studied, the farmers could not hire much labor and make a profit on truck crops. Cotton and cabbage were the only crops for which farmers could hire all labor and yet make a profit. The fact that there was a wide variation in returns per acre from year to year, and that a different crop was most profitable in each of the years studied probably explains why farmers continue to plant a given truck crop even though they might have lost money on it several years in succession.

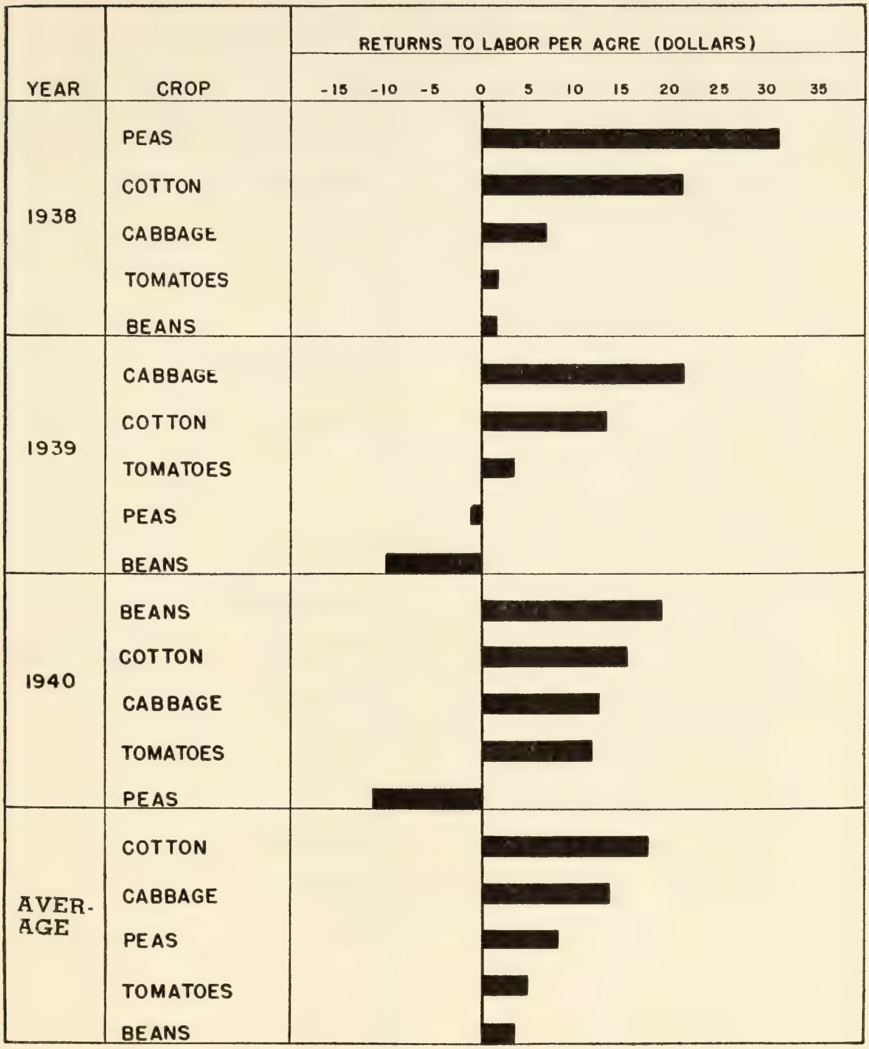

Figure 9. Returns to labor per acre for important crops, Copiah County, Mississippi, 1938-1940

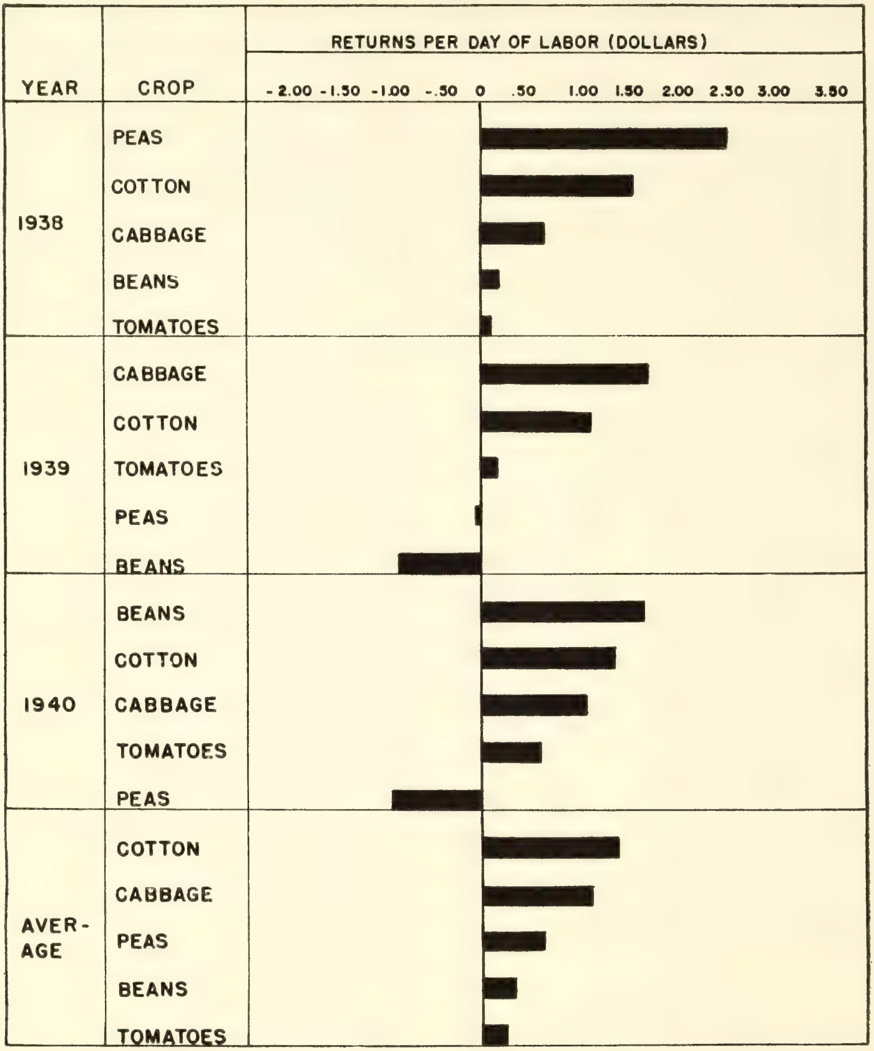

Figure 10. Returns per day of labor for important crops, Copiah County, Mississippi, 1938-1940

AGRICULTURAL CREDIT IN COPIAH COUNTY

Long Term

Fifty-six percent of the farm owners in 1938, 58 percent in 1939, and 55 percent in 1940, had mortgages against their farms, which averaged $2,541, $1,900, and $1,770, respectively, per farm mortgaged (Table 23). Taking all farms operated by owners into consideration, the average mortgage indebtedness per farm was $1,424 in 1938, $1,101 in 1939, and $935 in 1940. The farm mortgage debt on all farms operated by owners amounted to 31 percent of the total value of land and buildings in 1938, 29 percent in 1939, and 26 percent in 1940. This seems to indicate that the farmers were meeting their long-term obligations as they came due, even though the past three years have been unfavorable to truck farming. Eighty-nine percent of the total mortgage indebtedness was held by the Federal Land Bank in 1938, 86 percent in 1939, and 68 percent in 1940. Local banks and individuals were the next two most important sources of long-term credit. The Federal Land Bank charged 4.5 percent interest on money loaned; whereas, the local banks and individuals charged from 6 to 8 percent.

Since the major portion of the long term credit is secured from the Federal Land Bank, this type of credit is on a rather sound basis. To use credit wisely the truck grower should have a definite financial plan adapted to the amount of property owned and cash income. This plan might better err on the side of conservatism and should allow for emergencies. A study of the general economic cycle will help in the intelligent selection of a financing agency with an eye to emergencies. The fundamental feature of any financial plan is the proper balance between income and expense.

Short Term

Eighty-one percent of the farmers in 1938, 80 percent in 1939, and 71 percent in 1940, used short term credit, which averaged $801, $754, and $847, respectively per farm using credit. Taking all farms into consideration, the average amount of short term credit used per farm was $651 in 1938, $603 in 1939 and $604 in 1940 (Table 24). The Truck Growers' Association was the most important source of short term credit used the first two years, constituting 32 percent of the total short term credit in 1938 and 44 percent in 1939. Local stores were the most important source in 1940, making up 32 percent of the short term credit. The Jackson Production Credit Association, local banks, and the Farm Security Administration were other sources of short term credit. The rate of interest charged by the Production Credit Association was 5 percent for the actual time used. The Truck Growers' Association and local stores increased the price of goods sold to credit purchasers over cash prices. These loans were seldom made for a period of over 6 months, as this is about the length of turnover for truck crops.

Since approximately 54 percent of the farmers using credit used store or dealer credit, it is evident that great savings could be brought about by their getting in a position to pay cash and receive a discount or by shifting to less expensive sources of credit such as the Production Credit Association. Merchant credit costs farmers more because merchants charge higher prices for credit purchases than for cash purchases to cover interest and other service charges. These additional costs are due to interest on funds tied up in accounts, added bookkeeping costs, and losses on bad debts.

Table 23. Long Term Credit, Copiah County, Mississippi, 1938-1940

Source of Credit	1938			1939			1940		
	Farms	Total indebtedness	Average indebtedness per farm	Farms	Total indebtedness	Average indebtedness per farm	Farms	Total indebtedness	Average indebtedness per farm
	Number	Dollars	Dollars	Number	Dollars	Dollars	Number	Dollars	Dollars
Federal Land Bank	33	83,300	2,524	33	65,150	1,974	29	44,455	1,533
Local banks	3	10,180	3,393	4	6,930	1,733	3	13,000	4,333
Individuals	1	500	500	3	3,900	1,300	3	1,125	375
Other	0	—	—	0	—	—	2	6,900	3,450
All farms mortgaged	37	93,980	2,540	40	75,980	1,900	37	65,480	1,770
Farms with no mortgage	29	—	—	29	—	—	33	—	—
All farms[1]	66	93,980	1,424	69	75,980	1,101	70	65,480	935

[1] Includes only farm owners.

Table 24. Short Term Credit, Copiah County, Mississippi, 1938-1940

Source of Credit	1938			1939			1940		
	Farms	Total amount of credit	Average credit used per farm	Farms	Total amount of credit	Average credit used per farm	Farms	Total amount of credit	Average credit used per farm
	Number	Dollars	Dollars	Number	Dollars	Dollars	Number	Dollars	Dollars
Truck Growers' Assn.	21	16,900	805	20	21,306	1,065	13	13,000	1,000
Jackson Production Credit Association	18	16,166	898	12	6,932	578	12	14,455	1,205
Local stores	11	12,655	1,150	19	14,720	775	16	15,540	971
Local banks	9	4,825	536	8	3,925	491	8	3,650	456
Farm Security Adm.	4	942	236	5	1,377	275	5	1,198	240
Other	2	585	293	0	—		3	450	150
All farms using credit	65	52,073	801	64	48,260	754	57	48,293	847
Farms using no credit	15	—	—	16	—	—	23	—	—
All farms	80	52,073	651	80	48,260	603	80	48,293	604

APPENDIX

Table 25. Carlot Shipments of Vegetables from Copiah County with Comparisons to Mississippi Carlot Shipments, 1931-1940[1]

Year	Tomatoes	Cabbage	Mixed Vegetables	Beans[2]	Peas	Peppers	Others[3]	Total
1931	1,935	1,047	591	65	257	2	19	3,916
1932	2,080	615	448	100	29	3	11	3,286
1933	1,767	706	404	24	86	4	2	2,993
1934	2,200	1,512	380	256	156	12	1	4,517
1935	1,776	1,512	345	250	127	19	5	4,034
1936	1,761	1,930	343	317	250	12	9	4,622
1937	1,571	1,827	348	141	230	41	4	4,162
1938	2,157	2,152	230	142	170	27	0	4,878
1939	1,531	2,111	214	135	90	20	1	4,102
1940	751	1,253	112	43	20	5	0	2,184
Average, 1931-40	1,753	1,466	342	147	142	14	5	3,869
Miss. Shipments Average, 1931-40	2,355	1,708	512	237	151	15	549	5,527
Per cent Copiah Shipments are of Miss. Shipments	74	86	67	62	94	93	1	70

[1] Data obtained from the Market News Service, United States Department of Agriculture, Bureau of Agricultural Economics, Washington, D. C.

[2] Includes snap beans and lima beans.

[3] Includes beets, carrots, corn, cucumbers, greens, onions, potatoes, sweet potatoes, turnips, and rutabagas and spinach.

Table 26. Carlot Shipments of Vegetables by Months from Copiah County, Mississippi, 10-year Average, 1931-1940[1]

Month	Tomatoes	Cabbage	Mixed Vegetables	Beans	Peas	Peppers	Others	Total	Per Cent of Yearly Shipments
January							1	1	[3]
February								0	0
March		[2]	[2]		1		[2]	1	[3]
April		190	58		97			345	8.9
May	151	1,235	228	91	44		1	1,750	45.2
June	1,574	41	47	54	[2]	6	3	1,725	44.6
July	28		8			8	[2]	45	1.2
August			[2]			[2]		[2]	[3]
September				[2]				[2]	[3]
October				2				[2]	[3]
November							[2]	[2]	[3]
December							[2]	[2]	[3]
Total	1,753	1,466	342	147	142	14	5	3,869	100.0
Per Cent of Total Shipments	45.3	37.9	8.8	3.8	3.7	.4	.1	100.0	

[1] Data obtained from the Market News Service, United States Department of Agriculture, Bureau of Agricultural Economics, Washington, D. C.

[2] Less than one-half car.

[3] Less than .1 per cent.

Table 27. Yearly Average Farm Prices Received by Mississippi Farmers for Important Truck Crops, 1931-1940[1]

Year	Beans (Bu. of 20 lbs.)	Cabbage (Short ton)	Peas (Bu. of 30 lbs.)	Peppers (Bu. of 25 lbs.)	Tomatoes (Bu. of 53 lbs.)
	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
1931	.75	13.50	1.12	.30	1.07
1932	.60	50.00	1.15	.90	1.85
1933	1.10	32.50	.84	.30	1.80
1934	.55	6.10	1.31	.50	.65
1935	.64	22.50	.88	.55	1.10
1936	1.20	10.30	.90	.65	1.15
1937	.90	30.80	1.05	.55	1.40
1938	.67	8.00	1.40	.50	.75
1939	.55	15.50	.75	1.30	.60
1940	1.23	14.40	.85	.80	.65
Average 1931-1940	.82	20.36	1.03	.64	1.10

[1] Data compiled from mimeographed releases of the Crop Reporting Board of the United States Department of Agriculture.

Table 28. The Acreage, Production, and Average Price Received by Producer Per Unit for Important Truck Crops Produced in Mississippi and Competing States[1]

Competing States	Acreage		Production		Average Price Per Unit	
	1939	1940	1939	1940	1939	1940
Beans	(Number)		(1000 bushels)		Dollars	
Alabama	800	800	60	36	.45	1.00
Georgia	3,500	4,200	280	210	.80	1.00
Louisiana	9,200	7,300	506	402	.90	1.15
Mississippi	4,800	4,100	312	226	.55	1.23
South Carolina	7,200	7,200	504	432	.85	.91
Group Total	25,500	23,600	1,662	1,306	.71	1.06
Cabbage			(Tons)			
Alabama	1,200	1,400	6,000	7,000	30.00	22.00
Georgia, South	2,200	2,700	9,700	11,900	20.00	18.50
Louisiana	4,600	4,600	16,600	16,600	20.50	24.00
Mississippi	7,300	7,000	41,600	28,000	15.50	14.40
North Carolina	1,900	2,200	6,600	9,900	15.00	12.00
South Carolina	1,800	2,200	14,400	11,000	38.00	17.00
Virginia	4,200	4,200	18,100	19,600	13.48	16.00
Group Total	23,200	24,300	113,000	104,000	21.78	17.70
Peas			(1000 bushels)			
Alabama	——	——	——	——	——	——
California[2]	33,000	20,700	2,805	1,760	1.15	1.25
Louisiana	1,250	900	62	45	1.25	1.65
Mississippi	2,500	1,600	100	64	.75	.85
South Carolina	4,600	4,000	161	200	.70	.90
Group Total	41,350	27,200	3,128	2,069	.96	1.16
Tomatoes			(1000 bushels)			
Georgia	5,500	6,500	330	520	2.00	.70
Louisiana	3,000	3,300	216	264	1.15	.80
Mississippi	9,000	5,800	900	444	.60	.65
South Carolina	7,000	7,700	350	462	1.85	1.00
Texas[3]	27,200	29,400	1,768	2,205	1.45	.75
Group Total	51,700	52,700	3,564	3,895	1.21	.78

[1] United States Department of Agriculture, Crop Reporting Board, December 18, 1940.

[2] Excluding the Imperial Valley.

[3] Excluding the Lower Valley.

Table 29. Acreage of Important Commercial Truck Crops in Mississippi, 1931-1940[1]

Year	Beans	Cabbage	Peas	Peppers	Tomatoes
1931	5,200	3,100	2,350	100	9,600
1932	5,900	2,900	1,800	160	9,500
1933	3,600	3,500	2,100	240	10,300
1934	4,550	5,800	1,720	150	12,000
1935	5,950	5,800	1,800	150	9,750
1936	5,250	6,600	2,500	200	9,800
1937	7,050	6,400	3,000	250	9,500
1938	5,000	6,900	2,700	200	10,000
1939	4,800	7,300	2,500	200	9,000
1940	4,100	7,000	1,600	200	5,800
Average 1931-1940	5,037	5,530	2,207	185	9,525

[1] United States Department of Agriculture, Crops and Markets (December issue), 1931-1940.

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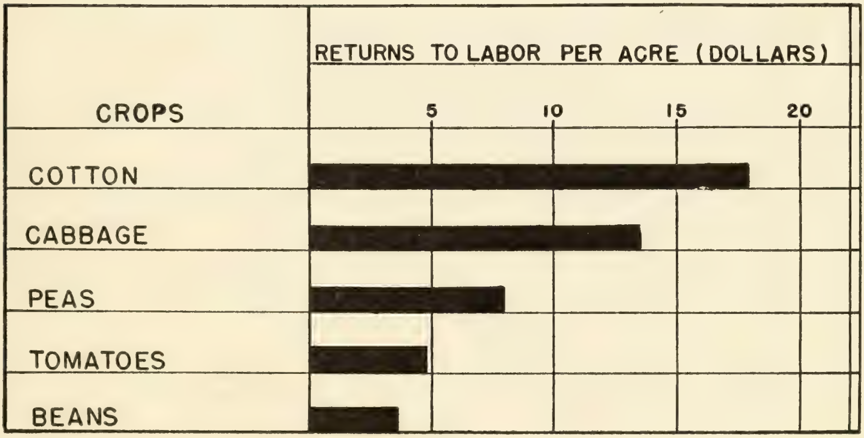
AN ECONOMIC STUDY OF TRUCK FARMING IN COPIAH COUNTY, MISSISSIPPI

1938-1940



Average Returns to Labor Per Acre For Different Crops,
Copiah County, Mississippi, 1938-1940

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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SUMMARY

This study was made by taking survey records on 80 farms in Copiah County, Mississippi. This county is located in the southwestern part of the State and makes up the greater part of the truck farm area. This county alone provided 1/3 of the vegetables shipped from Mississippi during the period 1931-1940.

The average size farm in the survey had 131 acres total farm land and 55 acres of crops.

The average investment per farm was $4,950 in 1938, $4,198 in 1939, and $4,369 in 1940. Approximately three-fourths of this total investment was in real estate.

In terms of acres, corn was the most important crop grown. Corn accounted for 41 percent of the total acres of crops, cabbage 14 percent, cotton 13 percent and tomatoes 12 percent. Twenty-one acres, or 39 percent of the total acres of crops, were planted to truck crops.

Receipts per farm were $1,950 in 1938, $1,688 in 1939, $1,560 in 1940, and averaged $1,733 for the three years. Cabbage, tomatoes and cotton, in the order named, were the most important sources of farm receipts. The four major truck crops, cabbage, tomatoes, peas and beans, accounted for over one-half of the farm receipts in each of the years studied.

Expenses per farm were $1,702 in 1938, $1,467 in 1939, $1,441 in 1940, and averaged $1,537 for the three years. Labor and fertilizer were the most important items of expense, constituting 34 and 27 percent, respectively, of the total farm expenses.

The farm privileges per farm amounted to $305 in 1938, $299 in 1939, and $284 in 1940, and averaged $296 for the three years. The farm privileges exceeded the farm income $57 in 1938, $78 in 1939, and $165 in 1940.

The labor income per farm was $50 in 1938, $54 in 1939, minus $55 in 1940, and averaged $16 for the three years. The majority of the farms had a labor income within the range of minus $250 to $250. Forty-three of the 80 farms surveyed in 1938, 35 in 1939, and 46 in 1940, had a minus labor income.

Marketing efficiency and production efficiency were the most important factors in accounting for high incomes on some farms and low incomes on others. In each of the years studied the farms with the lowest marketing efficiency had the lowest labor income, and in all cases, except one, the farms with the highest marketing efficiency had the highest labor income. As production efficiency increased, labor income increased.

The twenty most profitable farms and the twenty least profitable farms were compared with regard to a number of factors. In 1938 and 1939 the most profitable and least profitable farms were approximately the same size, but in 1940 the least profitable farms were much larger. In each of the years studied the most profitable farms used capital more efficiently, had higher crop yields, secured higher price for products sold, and had a smaller percentage of cash receipts from truck crops and had a higher percentage of cash receipts from cotton and livestock than did the least profitable farms.

The five major cash crops were analyzed to determine the profitableness of each. Three measures of profitableness were used: (1) net returns per acre; (2) returns to labor per acre; and (3) returns per day of labor. The profitableness of the individual crops varied greatly from year to year, and a different crop was most profitable in each of the years studied. For this reason the average for the three years is given below.

The average net returns per acre were: cotton $5.26, cabbage $2.16, peas minus $4.84, beans minus $6.60, and tomatoes minus $14.26.

The average returns to labor per acre were: cotton $17.61, cabbage $13.62, peas $8.01, tomatoes $4.92, and beans $3.53.

The average returns per day of labor were: cotton $1.43, cabbage $1.18, peas $0.66, beans $0.35, and tomatoes $0.26.

It is evident that during the period studied farmers could not hire much labor and expect to make a profit on truck crops. Cotton and cabbage were the only crops on which farmers could hire all labor and make a profit. The fact that there was a wide variation in returns per acre from year to year and that a different crop was most profitable in each of the years studied probably explains why farmers continue to plant a given truck crop even though they might have lost money on it several years in succession.

An Economic Study of Truck Farming in Copiah County, Mississippi, 1938-1940

By

Marvin Guin and D. W. Parvin

INTRODUCTION

Truck crops are the most important source of income to farmers in Copiah County. Soil and climatic conditions are favorable to the production of a wide range of vegetables. The County is favorably situated with reference to labor needs. Seasonal labor needs can be easily met by drawing from surrounding farms and from nearby villages and towns.

For the past three years, the income to truck growers has been low due to low prices of commodities. The timeliness of marketing is an important factor in the sale of truck crops. A few days delay may mean the difference between prices that insure a profit and prices that mean an operating loss.

The objectives of the study are (a) to make an analysis of the farm practices within the County, (b) to determine the relative profitableness of individual farms, (c) to determine the cost of production of important crops, (d) and finally to indicate the farm management practices that have proved to be most successful.

Materials and Methods

Survey records of farm businesses for the years[1] 1938, 1939, and 1940 were obtained from 80 typical farmers. The majority of the farms surveyed were owner-operated. Only a few renters were interviewed and these were cash renters.

A detailed record of the year's farm business was secured each year, showing inventories, receipts, expenses, production and marketing practices, and the farm organization with respect to crops and livestock. An effort was made to obtain records on the same farms each year, even though the farm had changed operators. Through the assistance of the vocational agricultural teacher at Crystal Springs and representative shippers, an impartial selection of the farmers' names was secured, care being taken to secure a representative sample of the area studied. The object was to get a representative cross-section of the truck enterprise, avoiding too large a portion of either the better or poorer farms or farmers.[2] The data were obtained by personal interviews and based largely on careful detailed estimates made by the farmers; books and records were used whenever available. The location of the area studied is shown graphically in figure 1.

The U. S. Department of Agriculture Yearbooks and publications of the Bureau of Agricultural Economics were used in obtaining statistical data for the area.

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[1] The fiscal year began August 1 and ended July 31.

[2] Since the farms had an average of 1.5 share tenants and family, the definition of a farm in this study differs from the United States Census definition in which each tenant with three acres of land or agricultural products valued at $250.00 or more is called a farmer.

The farm records are analyzed from the standpoint of the farm as a business unit, and important business relationships studied and summarized. The most important truck crops in the county are described in detail and various practices pointed out.

Definition of terms

Acres Operated: The total amount of farm land operated as a unit.

Farm capital: The value of the real estate, livestock, equipment, feed, seed, and other supplies.

Animal unit: A mature horse or cow or the equivalent in other livestock based upon the amount of feed consumed and manure produced; 2 calves, heifers, or colts; 7 sheep, 14 lambs, 5 hogs, 10 pigs, and 100 hens are considered, respectively, as an animal unit.

Acres in crops: The number of acres of land used for crops during a season or year. If more than one crop is grown on any of the land during the year the acreage is counted but once in determining the acres in crops.

Acres of crops: The number of acres of crops planted or harvested during a year. If double cropping is practiced, the acres of crops will exceed the acres in crops.

Farm receipts: The receipts from crops, livestock, crops on hand for sale at end of year, livestock products sold, increase in inventory of livestock and in real estate and equipment, and miscellaneous receipts from man and horse labor, and rent. Government payments were included.

Farm expenses: Farm expenses actually incurred, such as for fertilizer, labor, ginning, repairs, decrease in feed and livestock inventories, and in equipment, and the value of unpaid family labor.

Farm income: The difference between total farm receipts and total farm expenses.

Labor income: The farm income, less 4 percent on the average investment. Labor income is what a farmer receives for his year's work in addition to interest on his investment, all farm expenses, having a house to live in and farm produce to use in the home.

Labor earnings: The labor income plus the value of the farm privileges. It represents the earnings of the labor of the operator.

Farm privileges: The value of food products and fuel furnished directly by the farm toward the family living. The value of the use of the house is not included.

Percent return on investment: Equals the farm income less the estimated value of the operator's labor, expressed as a percentage of the average investment.

Crop index: The weighted average yield of crops of any farm expressed as a percentage of the average yield of the area.

Price index: Expresses on a percentage basis the prices received by a particular farmer as compared with those received by all farmers included in this study.

Farm capital turnover: The ratio of the farm receipts to the farm capital.

Location and Description of Area Studied

Copiah County is located in the southwestern part of the State, in the Brown Loam and Coastal Plain soil areas. The most common soils are Norfolk, Memphis, Waverly, and Orangeburg. Norfolk, an ashy-gray upland soil with yellow clay subsoil, is fair for cotton, corn, legumes, and truck crops.

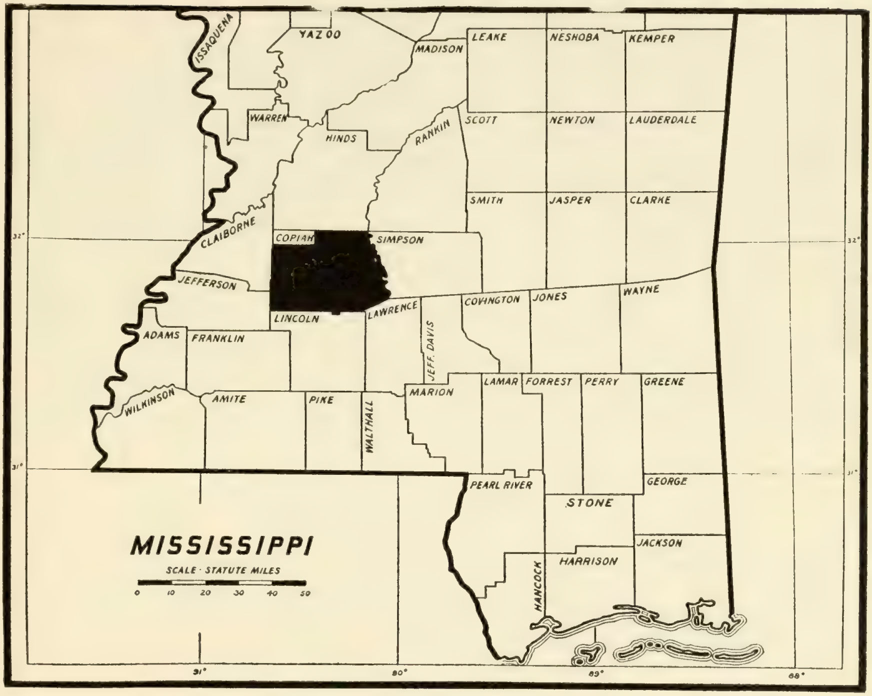
ISSAQUENA
YAZOO
MADISON
LEAKE
NESHOBA
KEMPER
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
32°
JEFFERSON
LINCOLN
LAWRENCE
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
JEFF. DAVIS
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
MARION
31°
PEARL RIVER
GEORGE
STONE
MISSISSIPPI
SCALE · STATUTE MILES
0 10 20 30 40 50
JACKSON
HARRISON
HANCOCK
91°
90°
89°
88°

Figure 1. Location of area studied

Memphis, a brown to grayish-brown upland soil with buff-colored subsoil, found only in the brown loam and Loess formation, is a good soil adapted to truck crops, cotton, corn, and legumes, although it is often badly damaged by erosion. Waverly is a "crawfish" land. It is a fair soil, adapted to cotton, corn, and legumes. Orangeburg is well drained, reddish in color, and is one of the most productive upland soils in the State. It is adapted to vegetables, cotton, corn, small grain, legumes and fruit trees.[3]

Copiah County's topography is gently rolling to rolling. The climate permits the growth of truck crops in the late winter. The winters are mild and the summers long and warm. The mean temperature for the years 1928-1937 was 66°F, and the average annual precipitation during the same period was 52 inches. The average growing season was 234 days, and the average first killing frost occurred November 13, and the last on March 24.[4]

Crystal Springs and Hazlehurst are the principal shipping centers. Crystal Springs with a population of 2,887 in 1940[5] is the center of the truck farming industry.

Hazlehurst is the county seat with a population of 3,128 in 1940. The Illinois Central Railway and Highway 51 traverse the county.

Copiah County is the most important commercial vegetable producing area in the State. Seventy-four percent of the tomatoes, 86 percent of the cabbage, 94 percent of the green peas, 62 percent of the beans (snap and

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[3] J. S. Scott, Federal Land Bank, Soil Guide, New Orleans, La.

[4] R. T. Lindley, Climatological Data, U. S. Dept. of Agriculture Weather Bureau, 1928-1937.

[5] U. S. Census reports, 1940.

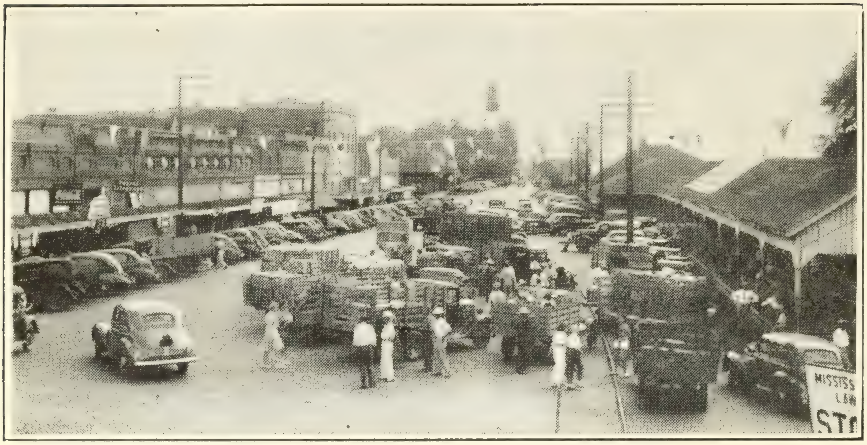

Figure 2. A common street scene during the truck crop marketing season, Crystal Springs, Mississippi

lima), and 93 percent of the peppers shipped from Mississippi for the 10-year period 1930-1939 came from Copiah County. The total shipments from Copiah County constituted 70 percent of the vegetables shipped from the State during this period.

FARM ORGANIZATION

Land Use

The average size farm surveyed was 131 acres, of which 37 acres, or 28 percent, was in crops. Eighteen acres, or 49 percent of the acres in crops were double-cropped giving a total of 55 acres of crops per farm (Table 1).

Table 1. Land Use, 80 Farms, Copiah County, Mississippi, 1938-1940

Year	Average per farm					
	Acres operated	Acres in crops	Acres of crops	Acres double-cropped	Percent of acres operated in crops	Percent of acres in crops double-cropped
1938	141	42	62	20	30	48
1939	121	34	52	18	28	53
1940	131	35	51	16	27	46
Average	131	37	55	18	28	49

The average size farm varied from 121 acres in 1939 to 141 acres in 1938. Acres in crops varied from 34 acres in 1939 to 42 acres in 1938; and acres of crops varied from 51 acres in 1940 to 62 acres in 1938. Twenty acres were double-cropped in 1938, 18 acres in 1939, and 16 acres in 1940. Thirty percent of the farm land was in crops in 1938, 28 percent in 1939, and 27 percent in 1940. Forty-eight percent of the acres in crops was double-cropped in 1938, 53 percent in 1939, and 46 percent in 1940. Practically 100 percent of the truck crops are followed by a second crop, usually corn, which accounts for the large acreage that is double-cropped. This is done in order to grow feed and to utilize the fertilizer that the truck crops failed to use.

Capital Invested

The average investment per farm was $4,506, or $122 per acre in crops. Of this total investment, 40 percent was in land, 35 percent in buildings, 8.6 percent in workstock, 8.5 percent in equipment, 7.1 percent in livestock and .6 percent in feed and seed (Table 2).

Table 2. Distribution of Capital, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average investment	Per-cent	Average investment	Per-cent	Average investment	Per-cent	Average investment	Per-cent
Land	$2,002	40.5	$1,735	41.3	$1,659	38.0	$1,799	39.9
Buildings	1,733	35.0	1,489	35.5	1,544	35.3	1,589	35.3
Workstock	465	9.4	305	7.3	397	9.1	389	8.6
Equipment	412	8.3	363	8.6	378	8.7	384	8.5
Livestock	308	6.2	278	6.6	369	8.4	318	7.1
Feed and seed inventory[1]	30	.6	28	.7	22	.5	27	.6
Total	$4,950	100.0	$4,198	100.0	$4,369	100.0	$4,506	100.0

[1] Inventory taken August 1.

The average investment per farm did not vary greatly during the period studied, ranging from $4,198 in 1939 to $4,950 in 1938. The percent that each item constituted of the total investment was likewise consistent from year to year. Real estate made up 76 percent of the total investment in 1938, 77 percent in 1939, and 73 percent in 1940; the percent of capital invested in workstock, equipment, livestock, and feed and seed varied even less. The investment per acre in land and buildings averaged $26 for the three years studied and did not vary greatly, ranging from $24 in 1940 to $27 in 1939.

Acres of Principal Crops

There was an average of 55 acres of crops per farm during the period studied (Table 3). Of this total acreage corn accounted for 41 percent, all truck crops 39 percent, cotton 13 percent, hay 6 percent, and miscellaneous crops 1 percent. Cabbage was the most important truck crop grown. Fourteen percent of the total acres of crops was devoted to cabbage, 12 percent to tomatoes, 4.5 percent to peas, 4.4 percent to beans and .7 percent to peppers.

Table 3. Acres of Crops, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Crops	Acres per farm	Per-cent	Acres per farm	Per-cent	Acres per farm	Per-cent	Acres per farm	Per-cent
Corn	24.2	39.0	21.8	41.9	21.4	42.1	22.5	40.9
All truck	23.7	38.2	21.3	41.0	18.5	36.4	21.2	38.5
Cabbage	8.2	13.2	7.8	15.0	7.5	14.8	7.8	14.2
Tomatoes	8.1	13.1	6.7	12.9	5.0	9.8	6.6	12.0
Peas	2.8	4.5	2.3	4.4	2.3	4.5	2.5	4.5
Beans	2.7	4.4	2.2	4.2	2.2	4.3	2.4	4.4
Sweetpotatoes	.9	1.5	.8	1.5	.6	1.2	.8	1.4
Peppers	.4	.6	.5	1.0	.4	.8	.4	.7
Irish potatoes	.2	.3	.3	.6	.2	.4	.2	.4
Miscellaneous truck	.4	.6	.7	1.4	.3	.6	.5	.9
Cotton	10.2	16.4	5.8	11.1	6.0	11.8	7.3	13.3
Hay	3.5	5.6	2.6	5.0	3.7	7.3	3.3	6.0
Miscellaneous	.5	.8	.5	1.0	1.2	2.4	.7	1.3
Total	62.1	100.0	52.0	100.0	50.8	100.0	55.0	100.0

In discussing the individual crops, the percent that a crop constitutes of the acres will be used instead of the number of acres, due to the fact that there was a variation of 11.3 acres of crops per farm between 1938 and 1940. The percent of acres of crops devoted to corn, peas, beans, and sweet potatoes did not vary greatly from 1938 to 1940. The percent of total acres de-

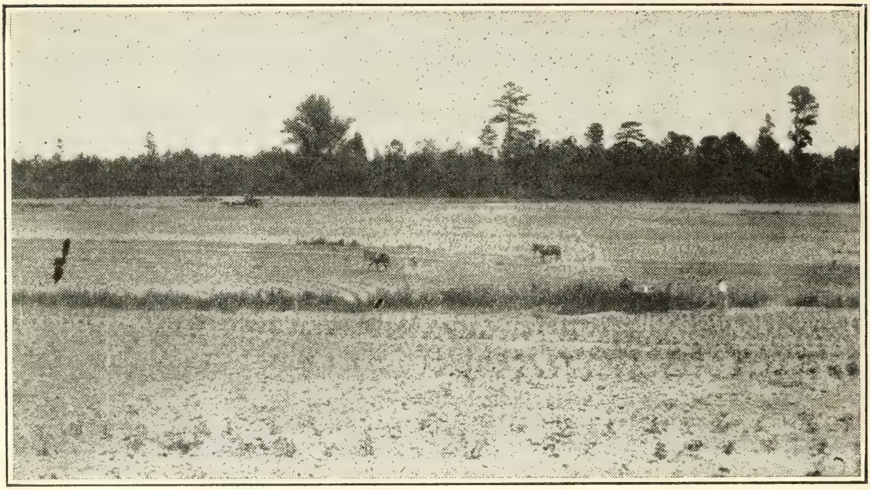

Figure 3. Typical method of cultivation in the truck crop area

voted to cabbage increased from 13 percent in 1938 to 15 percent in 1940, and the percent devoted to tomatoes decreased from 13 percent in 1938 to 10 percent in 1940. This indicates that farmers are replacing tomatoes with cabbage and other crops to some extent. The percent of land devoted to hay and miscellaneous crops increased from 1938 to 1940, while the percent of land devoted to cotton decreased.

Farm Receipts

Receipts per farm were $1,950 in 1938, $1,688 in 1939, $1,560 in 1940, and averaged $1,733 for the three years (Table 4). Cabbage was the most important source of farm receipts during the 3-year period. Cabbage accounted for 24 percent of the total farm receipts, tomatoes 19 percent, cotton 15 percent, peas 9 percent, beans 6 percent, livestock 10 percent and miscellaneous items 6 percent. The four major truck crops, cabbage, tomatoes, peas and beans, accounted for over one-half of the farm receipts in each of the years studied.

Table 4. Farm Receipts, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average farm receipts	Percent	Average farm receipts	Percent	Average farm receipts	Percent	Average farm receipts	Percent
Cabbage	$ 356	18.2	$ 508	30.1	$ 397	25.5	$ 420	24.2
Tomatoes	377	19.3	329	19.5	280	17.9	329	19.0
Cotton	401	20.5	178	10.5	183	11.7	254	14.7
Peas	231	11.9	119	7.1	90	5.8	147	8.5
Beans	103	5.3	62	3.7	130	8.3	98	5.7
Corn	78	4.0	60	3.5	65	4.2	68	3.9
Peppers	26	1.4	93	5.5	21	1.3	47	2.7
Sugarcane	22	1.1	20	1.2	27	1.7	23	1.3
Sweetpotatoes	31	1.6	17	1.0	20	1.3	23	1.3
Other crops	53	2.8	32	1.9	21	1.4	35	2.0
Livestock	180	9.2	169	10.0	186	11.9	178	10.3
Miscellaneous	92	4.7	101	6.0	140	9.0	111	6.4
Total	$1,950	100.0	$1,688	100.0	$1,560	100.0	$1,733	100.0

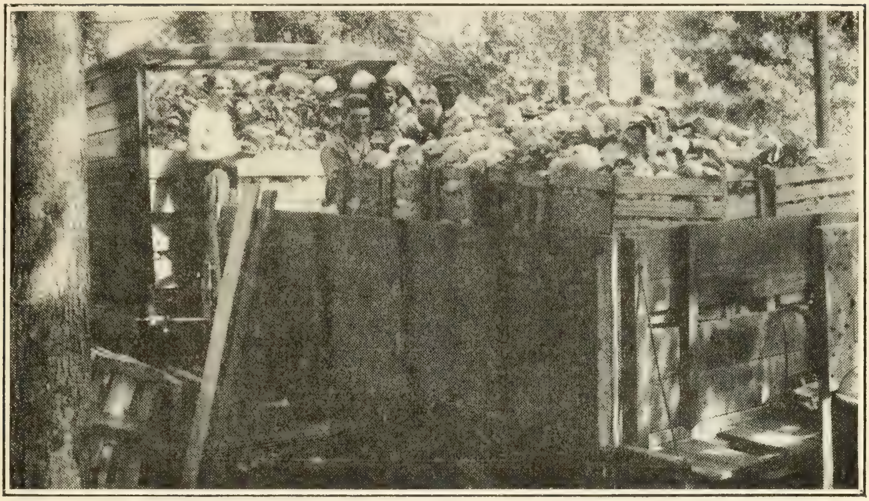

Figure 4. Reloading cabbage for transfer to central markets

Receipts from cabbage constituted 18 percent of the total farm receipts in 1938 as compared to 30 percent in 1939 and 26 percent in 1940. Nineteen percent of the farm receipts came from tomatoes in 1938 as compared to 18 percent in 1940. The percent of receipts from peas decreased consistently from 1938 to 1940. Receipts from beans constituted 5 percent of the total farm receipts in 1938, 4 percent in 1939, and 8 percent in 1940. Receipts from cotton decreased from 20 percent of the total in 1938 to 12 percent in 1940. Nine percent of the farm receipts came from livestock in 1938, 10 percent in 1939, and 12 percent in 1940. Receipts from miscellaneous items, which include government payments and increases in inventory, accounted for 5 percent of the farm receipts in 1938, 6 percent in 1939, and 9 percent in 1940. The foregoing discussion indicates that cabbage, beans, livestock and miscellaneous items are increasing in importance while tomatoes, cotton, and peas are decreasing in importance as sources of farm receipts.

Farm Expenses

Expenses per farm were $1,702 in 1938, $1,467 in 1939, $1,441 in 1940, and averaged $1,537 (Table 5). Labor and fertilizer were by far the most important items of expense, constituting 64 percent of the total expenses in 1938, 62 percent in 1939, 55 percent in 1940, and averaging 61 percent for the three years. During the same period decreases in inventory accounted for 10 percent of the farm expenses, containers 7 percent, seed 5 percent, truck expense 4 percent, taxes 3 percent and feed and insurance 2 percent each. The percent of farm expenses due to labor decreased from 40 percent in 1938 to 31 percent in 1939, and to 29 percent in 1940. From 1938 to 1940 farm expenses decreased $261 per farm, and during the same period the amount spent for labor decreased $276 per farm. This indicates that the farmers realize that one of the best ways to increase the farm income is to cut down on expenses. Since labor is the largest item of expense, it is logical to assume that farmers would begin here in cutting down expenses. However, this did not have the desired effect in 1939 and 1940, because the farm receipts decreased as much or more than did the farm expenses.

Table 5. Farm Expenses, 80 Farms, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Average expense	Percent	Average expense	Percent	Average expense	Percent	Average expense	Percent
Labor[1]	$ 687	40.3	$ 461	31.4	$ 411	28.5	$ 520	33.8
Fertilizer	409	24.0	453	30.9	376	26.1	413	26.9
Decrease in inventory	147	8.7	165	11.3	135	9.4	149	9.7
Containers	103	6.1	126	8.6	78	5.4	102	6.6
Seed	69	4.1	54	3.7	83	5.8	69	4.5
Truck expense	45	2.6	41	2.8	78	5.4	55	3.6
Taxes	66	3.9	30	2.0	39	2.7	45	2.9
Feed	13	.8	29	2.0	44	3.1	29	1.9
Insurance	30	1.7	28	1.9	26	1.8	28	1.8
Ginning	36	2.1	15	1.0	13	.9	21	1.4
Twine	17	1.0	15	1.0	16	1.1	16	1.0
Interest	10	.6	6	.4	8	.5	8	.5
Poison	9	.5	6	.4	7	.5	7	.5
Miscellaneous	61	3.6	38	2.6	127	8.8	75	4.9
Total	$1,702	100.0	$1,467	100.0	$1,441	100.0	$1,537	100.0

[1]Includes cost of cropper labor and unpaid family labor.

Farm Privileges

The farm privileges per farm amounted to $305 in 1938, $299 in 1939, $284 in 1940, and averaged $296 for the three years (Table 6). Each family consumed an average of 574 gallons of milk per year, 542 pounds of pork, 122 dozen eggs, 10 cords of wood and 37 head of poultry. Milk contributed more to the farm privileges than any other item. Milk accounted for 23 percent of the farm privileges, the garden and orchard 20 percent, pork 19 percent, miscellaneous crops 17 percent, eggs and fuel 8 percent each, and poultry 5 percent.

Table 6. Value of Farm Privileges, 80 Farms, Copiah County, Mississippi, 1938-1940

	Average per farm											
	1938			1939			1940			Average		
Item	Quantity	Value	Percent	Quantity	Value	Percent	Quantity	Value	Percent	Quantity	Value	Percent
Milk (gal)	560	$ 67	22.0	555	$ 61	20.4	606	$ 72	25.4	574	$ 67	22.6
Garden and orchard		57	18.7		56	18.7		61	21.5		58	19.6
Meat (pork) (lbs.)	533	59	19.2	520	65	21.7	572	46	16.2	542	57	19.3
Misc. crops[1]		53	17.4		57	19.1		41	14.4		50	16.9
Eggs (doz.)	138	28	9.1	110	22	7.4	118	23	8.1	122	24	8.1
Fuel (cords)	11	21	7.0	10	21	7.0	10	31	10.9	10	24	8.1
Poultry (hd.)	50	20	6.6	39	17	5.7	22	10	3.5	37	16	5.4
Total		$305	100.0		$299	100.0		$284	100.0		$296	100.0

[1]Includes corn, sweetpotatoes, Irish potatoes, peanuts and syrup.

Since the value of the products furnished the family by the farm averaged $296 per farm, it is an important factor to be considered in analyzing the farm business. It is interesting to note that the farm privileges actually exceeded the farm income each year. The farm privileges exceeded the farm income $57 in 1938, $78 in 1939, and $165 in 1940.

Profits

There are several measures of farm profits, of which labor income is the most commonly used. Labor income is the amount left at the end of the year for the farmer's labor and management after all expenses, and 4 percent interest on the average investment have been deducted. The labor income per farm was $50 in 1938, $54 in 1939, minus $55 in 1940, and averaged $16 for the three years (Table 7.)

Table 7. Summary of Farm Business, 80 Farms, Copiah County, Mississippi, 1938-1940

Item	Average per farm			
	1938	1939	1940	Average
Farm receipts	$1,950	$1,688	$1,560	$1,733
Farm expenses	1,702	1,467	1,441	1,537
Farm income	248	221	119	196
Interest on investment @ 4%	198	167	174	180
Labor income	50	54	— 55	16
Farm privileges	305	299	284	296
Labor earnings	355	353	229	312
Returned to capital	170	143	— 3	103
Percent returned to capital	3.4	3.4	— .1	2.4

The farm privileges were about the same for each year studied. Labor earnings averaged $355 per farm in 1938, $353 in 1939, and $229 in 1940. The average percent returned to capital was 2.4 percent, ranging from 3.4 percent in 1938 and 1939 to minus .1 percent in 1940.

Table 8. Variations in Labor Income, 80 Farms, Copiah County, Mississippi, 1938-1940

Labor income	1938		1939		1940	
	Number of farms	Average labor income	Number of farms	Average labor income	Number of farms	Average labor income
Less than —$1000	2	—$1427	2	—$1433	2	—$1339
—$1000 to — 750	1	— 754	3	— 922	1	— 851
— 750 to — 500	3	— 610	2	— 539	4	— 624
— 500 to — 250	13	— 390	9	— 326	13	— 349
— 250 to 0	24	— 116	19	— 104	26	— 141
0 to 250	21	123	21	106	23	94
250 to 500	5	333	14	316	6	355
500 to 750	4	576	4	638	2	676
750 to 1000	1	865	3	853	0	—
1000 or more	6	1643	3	1397	3	1385
Total or average	80	$ 50	80	$ 54	80	$ 55

The labor income per farm varied from minus $1,554 to $2,945 in 1938, from minus $1,842 to $1,889 in 1939, and from minus $1,446 to $1,878 in 1940. The majority of the farms had a labor income within the range of minus $250 to $250; 45 of the 80 farms were in this group in 1938, 40 in 1939, and 49 in 1940 (Table 8). Forty-three farms had a minus labor income in 1938, 35 in 1939, and 46 in 1940. Only 6 farms in 1938 and 3 farms each in 1939 and in 1940 had a labor income of more than $1,000. Only the most efficient farmers were able to return a plus labor income, due to the fact that the three years studied were extremely unfavorable for the production and sale of truck crops. The period was characterized by low yields and low prices, which in some cases were the result of low quality products.

FACTORS AFFECTING PROFITS

Size of Business

The size of farm business may be measured by several methods, such as acres of crops, capital invested, days of productive work, man equivalent, productive animal units and number of workstock. For the purpose of this study, however, acres of crops and capital invested will be used as measures of size.

There was no consistent relationship between size of business as measured by acres of crops and labor income, during the period studied. In 1938 the largest farms had the highest labor income; in 1939 the medium size farms, and in 1940 the smallest farms. In 1938, the labor income increased as the acres of crops increased, whereas in 1940 the labor income decreased as the acres of crops increased. In 1939 the medium size farms had the highest labor income, and the largest farms had the lowest (Table 9).

Table 9. Relation of Size of Business as Measured by Acres of Crops to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Acres of crops	Number of farms	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
					1938					
Less than 33	28	23	$1,917	2.3	64	17	8	98	104	$ 0
33-65	26	44	3,290	2.6	56	24	11	99	98	43
66 or more	26	124	9,879	2.6	59	21	8	101	98	110
Total or average	80	62	4,950	2.5	59	21	9	100	100	50
					1939					
Less than 29	27	21	1,907	2.7	69	12	12	100	98	41
29-59	27	41	3,307	2.3	68	11	10	105	104	200
60 or more	26	96	7,503	2.6	69	11	8	95	98	— 84
Total or average	80	52	4,198	2.5	69	11	10	100	100	54
					1940					
Less than 25	27	19	1,963	3.4	59	12	17	99	99	— 3
25-53	28	37	3,805	2.8	58	13	11	101	101	— 33
54 or more	25	101	7,596	2.2	71	11	7	99	99	—137
Total or average	80	51	4,369	2.8	62	12	12	100	100	— 55

In each of the three years the capital invested increased as the acres of crops increased. Capital efficiency was greatest on the small farms in 1938, on the medium size farms in 1939, and on the large farms in 1940. There was no consistent relation between acres of crops and production efficiency or marketing efficiency. Production efficiency was highest on the large farms in 1938, and on the medium size farms in 1939 and 1940. Marketing efficiency was highest on the small farms in 1938 and on the medium size farms in 1939 and 1940.

When size of business was measured by average capital, it was found that there was no consistent relationship between labor income and size of business. In 1938 and 1939 the medium size farms had the highest labor income, whereas in 1940 the small farms had the highest labor income; the small farms in 1938 and the large farms in 1939 and 1940 had the lowest labor income (Table 10). Acres in crops increased in each instance as capital invested increased. In each of the years the highest capital efficiency was found on the farms with the lowest capital investment. The highest production efficiency was found on the farms with the highest capital investment in 1938, and on the farms with a medium amount of capital in 1939 and 1940. Marketing efficiency was highest on the medium size farms in 1938 and 1939, and on small farms in 1940.

It is evident that during the past three years, size of business has not been one of the most important factors in determining profits. In general, the large farms have proved the least profitable. One would expect this, since large farms have a greater chance for loss in bad years.

Table 10. Relation of Size of Business as Measured by Average Capital to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Average capital	Number of farms	Average capital	Acres of crops	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
1938										
Less than $2500	27	$1,152	26	1.9	63	22	5	92	99	—$34
2500-4999	27	3,765	45	2.9	57	16	13	101	103	102
5000 or more	26	10,123	118	2.8	58	23	7	107	98	83
Total or average	80	$4,950	62	2.5	59	21	9	100	100	$50
1939										
Less than 2550	27	1,367	24	1.8	74	11	7	101	97	61
2550-4499	26	3,570	41	2.8	65	11	14	102	105	169
4500 or more	27	7,635	90	2.8	67	12	9	98	98	—63
Total or average	80	$4,198	52	2.5	69	11	10	100	100	$54
1940										
Less than 2500	26	1,388	22	2.2	65	12	12	96	103	27
2500-4499	28	3,425	39	3.1	59	13	14	102	98	8
4500 or more	26	8,364	93	3.1	62	12	10	99	97	—206
Total or average	80	$4,369	51	2.8	62	12	12	100	100	—$55

Production Efficiency

Production efficiency is one of the chief factors to be considered in accounting for high incomes on some farms and low incomes on others. Production efficiency of crops was measured by a factor known as crop index, which is the yields of the major crops on each farm expressed as a percentage of the average yield of the area.

Table 11. Relation of Crop Index to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Crop index	Number of farms	Crop index	Price index	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Labor income
1938										
Less than 88	27	77	100	48	$3,330	2.8	58	19	8	—$123
88-103	26	98	101	58	4,595	2.3	61	19	12	105
104 or more	27	124	99	82	6,909	2.4	59	23	7	169
Total or average	80	100	100	62	$4,950	2.5	59	21	9	$50
1939										
Less than 91	27	78	93	63	4,819	2.8	69	9	13	— 174
91-110	28	97	104	47	3,647	2.7	67	13	9	53
111 or more	25	127	104	45	4,147	2.0	70	12	8	302
Total or average	80	100	100	52	$4,198	2.5	69	11	10	$54
1940										
Less than 90	27	76	94	49	3,888	2.9	55	12	16	— 195
90-105	25	99	104	63	5,757	3.2	64	13	12	— 70
106 or more	28	123	101	42	3,587	2.3	67	12	9	94
Total or average	80	100	100	51	$4,369	2.8	62	12	12	— $55

During each of the three years studied, labor income increased as crop indices increased. Each year the farms with the highest production efficiency had the highest labor income, and the farms with the lowest production efficiency had the lowest labor income (Table 11). The farms with highest production efficiency had $292 more labor income per farm than did the farms with the poorest production efficiency in 1938, $476 more in 1939, and $289 more in 1940. There was no consistent relationship between production efficiency and marketing efficiency, capital efficiency, or size of business during the three years studied.

Production efficiency seemed to be one of the most important factors in determining farm incomes, since in each instance as production efficiency increased the labor income increased. This was true in only one other case; namely, capital efficiency.

Marketing Efficiency

Marketing or price efficiency was measured by a factor known as price index, which is the ratio of the prices received by each farmer to the average price received by all farmers studied. The price index is an average of the prices of commodities sold, weighted by the value of the products sold. The price index reflects to some extent the farmers' marketing ability, and also the quality of the products sold.

Table 12. Relation of Price Index to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Price index	Number of farms	Price index	Crop index	Acres of crops	Average capital	Farm capital turnover	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Labor income
					1938					
Less than 97	27	85	98	59	$4,251	2.7	65	18	6	—$232
97-104	26	99	107	76	6,188	2.4	45	30	14	250
105 or more	27	116	95	54	4,456	2.3	67	14	6	139
Total or average	80	100	100	62	$4,950	2.5	59	21	9	$50
					1939					
Less than 84	26	78	93	47	$3,686	3.1	66	13	9	—$229
84-100	28	94	103	60	4,881	2.4	67	12	11	81
101 or more	26	125	104	48	3,976	2.0	74	9	9	308
Total or average	80	100	100	52	$4,198	2.5	69	11	10	$54
					1940					
Less than 91	28	87	95	50	$4,087	3.1	60	12	12	—$238
91-99	29	98	98	50	4,560	3.0	56	12	14	— 66
100 or more	23	118	107	52	4,467	2.0	72	10	8	181
Total or average	80	100	100	51	$4,369	2.8	62	12	12	— $55

In each of the years studied, the farms with lowest marketing efficiency had the lowest labor income and in all cases except one the farms with the highest marketing efficiency had the highest labor income (Table 12). The farms with the highest marketing efficiency had $371 more labor income per farm than did the farms with the lowest marketing efficiency in 1938, $537 more in 1939, and $419 more in 1940. In 1939 and 1940, production efficiency increased as marketing efficiency increased, but this was not true in 1938. When size of business is measured by average capital, the medium size farms had highest marketing efficiency during each of the years studied. There was a definite relationship between marketing efficiency and capital efficiency (farm capital turnover). As marketing efficiency increased capital efficiency increased each year.

Capital Efficiency

Capital efficiency was measured by the factor, farm capital turnover, which is the number of years required for farm receipts to equal the farm capital. It is obtained by dividing the farm receipts into the farm capital. There was a direct relationship between capital efficiency and labor income, in all cases as capital efficiency increased, the labor income increased (Table 13). The farms with the highest capital efficiency had $399 more labor income per farm than did the farms with the lowest capital efficiency in 1938, $337 more in 1939, and $375 more in 1940.

Table 13. Relation of Capital Efficiency (Farm Capital Turn-over) to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Farm capital turnover	Number of farms	Farm capital turnover	Average capital	Acres of crops	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Crop index	Price index	Labor income
					1938					
Less than 2.0	27	1.2	$2,401	47	64	16	10	97	103	$ 256
2.0-3.1	26	2.4	6,973	87	61	20	9	102	100	36
3.2 or more	27	3.9	5,549	55	53	25	7	100	97	—143
Total or average	80	2.5	$4,950	62	59	21	9	100	100	$ 50
					1939					
Less than 2.0	27	1.2	$2,748	47	76	8	9	105	110	$ 239
2.0-3.0	27	2.4	5,062	63	70	11	8	99	98	16
3.1 or more	26	4.0	4,808	45	61	13	13	95	92	— 98
Total or average	80	2.5	$4,198	52	69	11	10	100	100	$ 54
					1940					
Less than 2.2	27	1.5	$3,658	60	69	10	11	106	105	$ 130
2.2-4.3	26	2.8	4,885	58	65	12	12	97	99	— 50
4.4 or more	27	4.8	4,573	35	51	14	14	96	95	—245
Total or average	80	2.8	$4,369	51	62	12	12	100	100	—$55

In each of the years studied, the farms with the highest capital efficiency had the smallest amount of capital invested. Marketing efficiency seemed to be a definite factor affecting capital efficiency, increasing consistently with increases in capital efficiency each year. Production efficiency decreased as capital efficiency increased in 1939 and 1940, but did not in 1938.

Balance of Farm Business

Balance deals with the number and adjustments of enterprises on the farms. Balance of farm business may be measured by several methods; but for this study only percent of cash receipts from important sources is used.

There was no consistent relationship between percent of cash receipts from truck crops and labor income during the period studied. Labor income was highest on farms with the lowest percent of cash receipts from truck crops in 1938 and 1940, and on the farms with the medium percent of cash receipts from truck crops in 1939 (Table 14). During each year the farms with receipts from truck crops had neither the highest or lowest labor income, but the farms with the highest percent of cash were found to have the smallest capital investment and the highest capital efficiency. The percent of cash receipts from truck crops did not seem to have much effect on production and marketing efficiency.

Labor income was highest on farms with the lowest percent of cash receipts from cotton in 1938 and 1939, and on the farms with the highest percent of cash receipts from cotton in 1940 (Table 15). Labor income was lowest each year on the farms with the medium percent of cash receipts from cotton. There was no relationship between size of business or capital efficiency and percent of cash receipts from cotton. Production efficiency was highest on the farms with the highest percent of cash receipts from cotton in 1939 and 1940, and on the farms with a medium percent of cash receipts from cotton in 1938. Marketing efficiency increased as the percent of cash receipts from cotton increased, except in 1940 when it remained constant.

Table 14. Relation of Percent of Cash Receipts from Truck Crops to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

		Average per farm								
Percent of cash receipts from truck crops	Number of farms	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Percent of cash receipts from livestock	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
1938										
Less than 50	27	34	34	15	64	$5,451	2.7	96	102	$ 150
50-70	27	61	20	8	60	4,908	2.6	107	96	—54
71 or more	26	84	6	4	63	4,472	2.1	97	103	53
Total or average	80	59	21	9	62	$4,950	2.5	100	100	$ 50
1939										
Less than 64	28	50	17	19	51	$4,580	2.8	100	96	5
64-76	25	71	12	7	53	4,822	2.8	106	103	147
77 or more	27	86	4	5	52	3,226	1.8	94	102	19
Total or average	80	69	11	10	52	$4,198	2.5	100	100	$ 54
1940										
Less than 50	26	33	19	22	35	$4,273	3.6	97	96	—$21
50-66	24	63	12	10	59	4,749	2.8	95	98	— 82
67 or more	30	86	6	4	57	4,146	2.2	105	104	— 64
Total or average	80	62	12	12	51	$4,369	2.8	100	100	—$55

Table 15. Relation of Percent of Cash Receipts from Cotton to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

		Average per farm								
Percent of cash receipts from cotton	Number of farms	Percent of cash receipts from cotton	Percent of cash receipts from truck crops	Percent of cash receipts from livestock	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
1938										
Less than 11	26	3	78	10	54	$3,702	2.1	94	102	$ 80
11-26	26	18	61	8	63	4,981	2.6	104	101	14
27 or more	28	39	40	9	70	6,079	2.7	101	97	55
Total or average	80	21	59	9	62	$4,950	2.5	100	100	$ 50
1939										
Less than 5	26	1	79	13	44	$3,288	2.3	96	103	$184
5-16	27	10	72	8	67	4,731	2.2	95	100	— 30
17 or more	27	23	56	9	44	4,543	3.0	109	97	13
Total or average	80	11	69	10	52	$4,198	2.5	100	100	$ 54
1940										
Less than 7	26	2	72	15	55	$4,446	2.7	99	100	—$21
7-16	27	10	67	11	56	4,596	2.7	96	100	—239
17 or more	27	24	47	11	41	4,058	3.1	103	100	95
Total or average	80	12	62	12	51	$4,369	2.8	100	100	—$55

When balance was measured by the percentage of cash receipts from livestock, it was found that in each year the farms with the highest percentage of cash receipts from livestock had the highest labor income (Table 16). Labor income was lowest on farms with a medium percent of cash receipts from livestock in 1938 and 1940, and on the farms with the smallest percent of cash receipts from livestock in 1939. The percentage of cash receipts from livestock did not appear to have much effect on size of business, capital efficiency, production efficiency, or marketing efficiency. In each case as the percent of cash receipts from livestock increased, the percent of cash receipts from truck crops decreased.

Table 16. Relation of Percent of Cash Receipts from Livestock to Profits and Other Factors Affecting Profits, Copiah County, Mississippi, 1938-1940

Percent of cash receipts from livestock	Number of farms	Average per farm								
		Percent of cash receipts from livestock	Percent of cash receipts from truck crops	Percent of cash receipts from cotton	Acres of crops	Average capital	Farm capital turnover	Crop index	Price index	Labor income
						1938				
Less than 3	26	1	69	20	52	$4,282	2.6	102	98	—$73
3-8	30	5	62	20	66	4,886	2.6	101	100	—160
9 or more	24	22	45	21	70	5,751	2.4	95	102	445
Total or average	80	9	59	21	62	$4,950	2.5	100	100	$50
						1939				
Less than 4	25	1	77	13	47	$3,431	2.2	103	101	—$79
4-12	28	7	74	9	67	5,163	2.3	102	102	28
13 or more	27	22	56	11	41	2,910	3.0	95	97	204
Total or average	80	10	69	11	52	$4,198	2.5	100	100	$54
						1940				
Less than 4	25	1	72	14	53	$3,445	2.3	103	98	—$73
4-11	28	6	70	12	59	4,972	2.7	104	101	— 84
12 or more	27	28	43	11	41	4,591	3.4	91	99	— 9
Total or average	80	12	62	12	51	$4,369	2.8	100	100	—$55

The foregoing discussion indicates that, in general, the farms with a high percent of cash receipts from livestock and a smaller percent of cash receipts from truck crop and cotton were more profitable.

Comparison of High and Low Profit Farms

The 20 most profitable farms and the 20 least profitable farms were compared with respect to several of the factors for success (Table 17). The 20 most profitable farms had an average labor income of $778 in 1938, $634 in 1939, and $456 in 1940, compared to minus $538 in 1938, minus $520 in 1939, and minus $528 in 1940, for the least profitable farms. In 1938 and 1939 the least profitable and most profitable farms were approximately the same size, but in 1940 the least profitable farms were much larger. In each of the years studied the most profitable farms used their capital more efficiently, had higher crop yields, sold products for higher prices, had a smaller percent of cash receipts from truck crops and a higher percent of cash receipts from cotton and livestock than did the least profitable farms.

When the three years were averaged, it was found that the 20 most profitable farms had an average of 59 acres of crops and $4911 capital invested. This compares with 71 acres of crops and $5816 capital invested for the 20 least profitable farms. It required an average of 1.7 years for the receipts to equal the farm capital on the 20 most profitable farms, as compared with 3.3

Figure 5. A high-yielding field of cabbage—the best paying truck crop during the years studied

years on the 20 least profitable farms. The 20 most profitable farms received 58 percent of the cash receipts from truck crops, 15 percent from cotton, and 16 percent from livestock; whereas the 20 least profitable farms received 68 percent of cash receipts from truck crops, 13 percent from cotton and 7 percent from livestock. The crop index was 10 percent above average on the 20 most profitable farms, and 11 percent below average on the 20 least profitable farms. The price index was 17 percent higher on the most profitable farms than on the 20 least profitable farms.

Table 17. Comparison of Certain Factors on Farms of Varying Success, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms	20 most profitable farms	20 least profitable farms
Acres of crops	79	78	54	54	44	80	59	71
Average capital (dollars)	6,144	5,729	4,682	4,682	3,907	7,037	4,911	5,816
Farm capital turnover	1.8	3.3	1.7	3.1	1.6	3.5	1.7	3.3
Percent of cash receipts from truck crops	50	63	67	73	58	68	58	68
Percent of cash receipts from cotton	21	18	10	10	14	10	15	13
Percent of cash receipts from livestock	18	5	14	6	16	10	16	7
Crop index	99	92	114	88	116	88	110	89
Price index	103	93	117	84	106	99	109	92
Labor income (dollars)	778	—538	634	—520	456	—528	623	—529

The foregoing discussion indicates that the most profitable farms were smaller in size, had higher crop yields, received higher prices and used capital more efficiently than the least profitable farms. The most profitable farms found it necessary to have a smaller percent of their cash receipts come from truck crops, and a larger percent from cotton and livestock than did the least profitable farms.

COMMODITY STUDIES

Cabbage

Cabbage ranked first in total acreage and in source of income among truck crops grown on the farms during the period investigated. Most of the cabbage produced in Copiah County are graded and packed at shippers' packing sheds or loading platforms on railroad sidings by experienced commercial packers. The western crate, holding from 85 to 100 pounds, and the pony crates are used, the former being more popular. Most of the cabbage are sold to local buyers for cash, f. o. b. shipping point. There are a few consignment and joint account sales. The shipments of cabbage from Copiah County increased from 1,047 cars in 1931 to 2,111 in 1939 but decreased to 1,253 in 1940. The shipment of 1,253 cars in 1940 was the lowest since 1923, when 706 cars were shipped (Table 25). Chicago, Detroit, St. Louis, and Pittsburg are the principal markets, while the larger cities in the North Central, Middle Atlantic, and North Atlantic States share in the car-lot movement. Considerable quantities are shipped to Canada during some years. None of the cabbage is used for canning purposes.

Table 18. Average Inputs,[1] Costs, and Returns per Acre of Cabbage, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,743	23.63	1,671	25.37	1,572	21.48	1,666	23.52
Man labor, hrs.	108	10.80	123	12.30	113	11.30	115	11.46
Rent		3.57		3.84		3.68		3.69
Crates		—	32	5.61	16	2.77	16	2.75
Horse labor, hrs.	50	2.50	47	2.35	45	2.25	47	2.37
Truck expense		2.02		1.95		2.55		2.17
Seed, ounces	8	1.00	8	.63	13	4.01[2]	10	1.84[2]
Coldframe, equipment		1.04		1.02		1.07		1.04
Straw		1.00		1.00		1.00		1.00
Equipment expense		.85		.75		.85		.82
Interest		.75		.69		.75		.73
Poison		.36		.27		.38		.34
Total cost		47.52		55.78		52.09		51.73
Value of cabbage per acre		43.70		65.15		53.24		53.89
Cost of cabbage per acre		47.52		55.78		52.09		51.73
Net returns per acre		— 3.82		9.37		1.15		2.16
Average price per ton		7.64		12.41		12.80		10.63
Average cost per ton		8.31		10.62		12.52		10.20
Net returns per ton		— .67		1.79		.28		.43
Returns to labor per acre[3]		6.98		21.67		12.45		13.62
Returns per day of labor[4]		.65		1.76		1.10		1.18
No. of farms growing		80		78		73		77
Total acres of cabbage		652		624		597		624
Yields in tons per acre		5.72		5.25		4.16		5.07

[1] The term "inputs" refers to the amounts of the production elements that are used in turning out a product.

[2] Includes cost of some plants.

[3] Net returns per acre plus the amount charged for man labor.

[4] Returns to labor divided by days of work. Ten hours is considered a day of work.

The first operation in preparation for the cabbage crop is the seeding of the cold frames in October. The first field operation consists of cutting stalks in December. The common practice is to subsoil with two furrows, put out fertilizer by hand, then bed, using four furrows with a turning plow. Harrowing with a one-horse implement is the next operation. The bed is then opened with a turning plow with moldboard removed, reharrowed, and the plants set out by hand. The seed bed is prepared and the plants set out in January.

The cabbage is usually given three complete cultivations consisting of from three to six furrows to the row per cultivation. The side dressing of a nitrate is applied during the second cultivation, and the last of the three usual cultivations occurs in March. Approximately 85 percent of the cabbage is harvested in May (Table 26).

An acre of cabbage required an average of 1,666 pounds of fertilizer, 115 man hours, 47 horse hours, 16 crates, and 10 ounces of seed for the three years studied (Table 18).

The average cost of producing an acre of cabbage was $51.73, and ranged from $47.52 in 1938 to $55.78 in 1939. Fertilizer was the most important item of expense. During the period studied fertilizer represented 46 percent of the total cost of production, man labor 22 percent, rent 7 percent and crates and horse labor 5 percent each.

The gross value of cabbage per acre was $43.70 in 1938, $65.15 in 1939, $53.24 in 1940, and averaged $53.89. The net returns per acre averaged $2.16 and ranged from minus $3.82 in 1938 to $9.37 in 1939. The average price received per ton of cabbage was $10.63; the average cost per ton was $10.20, leaving a net return of $0.43 per ton. The returns to labor per acre averaged $13.62 and ranged from $6.98 in 1938 to $21.67 in 1939. The returns per day of labor averaged $0.65 in 1938, $1.76 in 1939, $1.10 in 1940, and $1.18 for the three years.

Tomatoes

Tomatoes ranked second to cabbage in acreage and receipts during the three years studied. Carlot shipments of tomatoes from Copiah County decreased from 1,935 cars in 1931 to 1,531 cars in 1939, and to 751 cars in 1940. The shipment of 751 cars in 1940 was the lowest in over a decade, and amounted to less than one-half of the 1939 shipments. The price of 75 cents per bushel in 1938, 60 cents in 1939, and 65 cents in 1940* was far below the average price of $1.10 received by farmers during the past 10 years (1931-1940) (Table 27).

The first operation in the preparation for the tomato crop is the cutting of corn stalks in December. The hotbeds are seeded in January, and the tomato plants transplanted to cold frames in February. The preparation of the seed bed is the same as for cabbage, but is done in March. The tomatoes are usually given three to four complete cultivations consisting of from three to six furrows to the row per cultivation.

They are usually side dressed with a nitrate fertilizer during the second cultivation. Tomatoes are staked and tied in April, pruned three or four times in April and May, and topped following the last cultivation which occurs in May. About 90 percent of the tomatoes are harvested in June, most of the other 10 percent is harvested in late May, while a few are harvested in early July (Table 26).

During the three years studied, an acre of tomatoes required an average of 1,537 pounds of fertilizer, 192 man hours of work, 5,000 sticks, 45 horse hours of work, and 5 pounds of jute (Table 19). The average cost of producing an acre of tomatoes was $63.32, ranging from $61.55 in 1938 to $64.83 in 1939. Fertilizer represented 34 percent of the total cost of production, man labor 30 percent, rent and sticks 6 percent each, and lugs 4 percent.

The sales of tomatoes per acre amounted to $44.57 in 1938, $49.03 in 1939, $56.45 in 1940 and averaged $49.06. The net returns per acre averaged minus $14.26 and ranged from minus $7.71 in 1940 to minus $16.98 in 1938. The average price received for tomatoes was $0.50; the average cost was $0.64 per bushel, leaving a net return of minus $0.14 per bushel. The returns to labor per acre were $4.92, ranging from $1.92 in 1938 to $11.89 in 1940. The returns per day of labor were $0.10 in 1938, $0.18 in 1939, $0.61 in 1940, and averaged $0.26 for the three years.

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*The prices in this study were for unpacked tomatoes and do not agree with the census prices which were for packed tomatoes.

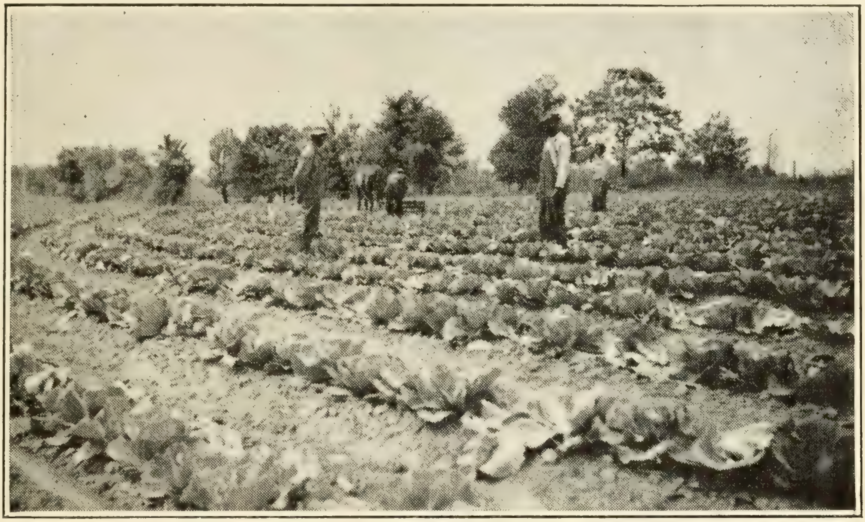

Figure 6. Harvesting cabbage. Cabbage are cut by hand and sledded out of fields

Table 19. Average Inputs, Cost, and Returns Per Acre of Tomatoes, Copiah County, Mississippi, 1938-1940

Item	1938		1939		1940		Average	
	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,628	21.80	1,484	22.18	1,462	19.93	1,537	21.46
Man labor, hrs.	189	18.90	192	19.20	196	19.60	192	19.18
Sticks	5,000	3.75	5,000	3.68	5,000	3.79	5,000	3.74
Rent		3.57		3.84		3.68		3.69
Lugs	—	—	42	4.65	38	3.84	24	2.54
Hotbed, equipment		2.50		2.45		2.54		2.49
Horse labor, hrs.	50	2.50	40	2.00	44	2.20	45	2.25
Truck expense		1.69		1.21		1.87		1.57
Coldframe, equipment		1.55		1.52		1.60		1.55
Jute (twine), lbs.	5	.96	5	1.04	6	1.24	5	1.06
Straw		1.00		1.00		1.00		1.00
Seed, ounces	2	1.25	1	46	1	.88[1]	1	.89
Equipment expense		.85		.64		.80		.77
Interest		.75		.59		.70		.68
Poison		.48		.37		.49		.45
Total cost		61.55		64.83		64.16		63.32
Value of tomatoes per a.		44.57		49.03		56.45		49.06
Cost of tomatoes per a.		61.55		64.83		64.16		63.32
Net returns per acre		—16.98		—15.80		— 7.71		—14.26
Average price per bushel		.39		.58		.58		.50
Average cost per bushel		.54		.76		.66		.64
Net returns per bushel		— .15		— .18		— .08		— .14
Returns to labor per a.		1.92		3.40		11.89		4.92
Returns per day of labor		.10		.18		.61		.26
No. of farms growing		79		80		71		77
Total acres of tomatoes		649		538		397		528
Yield in bu. per acre		113		85		97		99

[1] Includes cost of some plants.

Peas

Peas ranked third in importance among truck crops in Copiah County. An average of 142 cars of peas was shipped annually for the period 1931-1940. The shipment of 20 cars in 1940 was the lowest in over a decade (Table 25). The average farm price of peas for the period 1931-1940 was $1.03 per bushel. The price of peas was above average in 1938, but below average for the other two years (Table 27).

The first operation in the cultivation of peas is the cutting of stalks in December with a stalk cutter. Rows are then laid off with either a middle buster or a turning plow, and the fertilizer put out and covered with four furrows. The above-listed operations take place in early December. The beds are harrowed and planted about the first of February. The first cultivation takes place around March 1, consisting of scratching with a scratcher and running out the middles with a middle buster. The peas are staked and tied following the first cultivation. The second and final cultivation occurs about a week later, consisting of scratching with a scratcher and running around the rows with a sweep and plow, side dressing with a nitrate and covering with either a middle buster (one furrow) or a turning plow (two furrows). The peas are harvested in April and May.

Table 20. Average Inputs, Cost and Returns per Acre of Peas, Copiah County, Mississippi, 1938-1940

Item	1938		1939		1940		Average	
	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,382	18.47	1,344	20.11	1,376	19.11	1,369	19.18
Man labor, hrs.	122	12.20	145	14.50	120	12.00	128	12.85
Seed, lbs.	104	11.34	93	10.50	92	10.07	97	10.68
Hampers	72	7.20	78	8.58	56	6.16	69	7.30
Rent		3.57		3.84		3.68		3.69
Jute (twine), lbs.	16	3.27	17	3.57	19	4.23	17	3.66
Sticks	3,000	2.25	3,000	2.21	3,000	2.27	3,000	2.24
Horse labor, hrs.	33	1.65	32	1.60	30	1.50	32	1.59
Truck expense		1.27		1.39		1.72		1.45
Equipment expense		.56		.51		.57		.55
Interest		.50		.47		.50		.49
Poison		.35		.26		.35		.32
Total cost		62.63		67.54		62.16		64.00
Value of peas per acre		82.08		51.90		38.66		59.16
Cost of peas per acre		62.63		67.54		62.16		64.00
Net returns per acre		19.45		—15.64		—23.50		— 4.84
Average price per bu.		1.14		0.67		0.69		0.86
Average cost per bu.		.87		.87		1.11		.93
Net returns per bu.		.27		— .20		— .42		— .07
Returns to labor per a.		31.65		— 1.14		—11.50		8.01
Returns per da. of labor		2.59		— .08		— .96		.66
No. of farms growing		55		55		47		52
Total acres of peas		225		183		187		198
Yields in bu. per acre		72		78		56		69

The average of the farms surveyed shows that an acre of peas required 28 man hours of labor, 32 horse hours of labor, 1,369 pounds of fertilizer, 97 pounds of seed, and 17 pounds of jute (Table 20). The average cost of producing an acre of peas was $64.00, of which fertilizer was the most important item. Fertilizer represented 30 percent of the total cost of production; man labor 20 percent, seed 17 percent, hampers 11 percent and rent and jute 6 percent each.

The sales of peas per acre amounted to $82.08 in 1938, $51.90 in 1939, $38.66 in 1940, and averaged $59.16 for the three years. The net returns per acre of peas showed the greatest variation of any of the crops studied. The

Figure 7. Peas ready for harvest

net returns per acre averaged minus $4.84 and ranged from $19.45 in 1938 to minus $23.50 in 1940. The average price received per bushel of peas was $0.86, the average cost was $0.93, leaving a net return of minus $0.07 per bushel. The returns to labor per acre were $8.01, ranging from $31.65 in 1938 to minus $11.50 in 1940. The returns per day of labor were $2.59 in 1938, minus $0.08 in 1939, minus $0.96 in 1940, and averaged $0.66 for the three years.

Beans

Beans ranked fourth among truck crops as a source of cash income in Copiah County. The shipment of 43 cars in 1940 was the lowest since 1933, when only 24 cars were shipped. An average of 147 cars was shipped annually for the period 1931-1940 (Table 25).

In late February, the land for beans is laid off with a middle buster or turning plow; then the fertilizer put out and the land bedded, using four furrows. The land is harrowed, opened, and planted about the middle of March. The first cultivation occurs about April 10, consisting of scratching and running out the middles. The second cultivation occurs about a week later and consists of scratching with a scratcher (a one-horse cultivator) and running around with a sweep. The side dressing is placed in the furrow made by the sweep and covered, using two furrows with a turning plow. This is usually followed a week later by a light cultivation with a sweep or harrow. The beans are harvested in May and June.

An acre of beans required an average of 101 man hours, 33 horse hours, 1,348 pounds of fertilizer, 59 hampers and 50 pounds of seed during the period studied. The average cost of producing an acre of beans was $48.07 and ranged from $44.82 in 1938 to $50.19 in 1940. The average expenditures per acre for fertilizer amounted to 39 percent of the total cost, man labor 21 percent, hampers 13 percent, seed 10 percent, and rent 8 percent (Table 21).

The value of beans per acre was $41.47, ranging from $28.73 in 1939 to $57.98 in 1940. The net returns per acre were minus $6.82 in 1938, minus $21.22 in 1939, $7.79 in 1940, and averaged minus $6.60 for the three years. The average price received for beans was $0.70, the average cost was $0.81, leaving a net return of minus $0.11 per bushel. The returns to labor per acre averaged $3.53 and ranged from minus $10.02 in 1939 to $19.09 in 1940. The returns per day of labor were $0.18 in 1938, minus $0.89 in 1939, $1.69 in 1940, and averaged $0.35 for the three years.

Table 21. Average Inputs, Cost and Returns per Acre of Beans, Copiah County, Mississippi, 1938-1940

	1938		1939		1940		Average	
Item	Inputs	Cost	Inputs	Cost	Inputs	Cost	Inputs	Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Fertilizer, lbs.	1,497	20.20	1,279	19.27	1,236	16.99	1,318	18.90
Man labor, hrs.	83	8.30	112	11.20	113	11.30	101	10.13
Hampers	50	5.00	64	7.04	65	7.15	59	6.30
Seed, lbs.	45	4.50	45	4.20	60	6.67	50	5.09
Rent		3.57		3.84		3.68		3.69
Horse labor, hrs.	26	1.30	38	1.90	36	1.80	33	1.64
Truck expense		.88		1.14		1.30		1.09
Equipment expense		.44		.61		.55		.53
Interest		.39		.56		.49		.47
Poison		.24		.19		.26		.23
Total cost		44.82		49.95		50.19		48.07
Value of beans per acre		38.00		28.73		57.98		41.47
Cost of beans per acre		44.82		49.95		50.19		48.07
Net returns per acre		— 6.82		—21.22		7.79		— 6.60
Average price per bu.		.76		.45		.89		.70
Average cost per bu.		.90		.78		.77		— .81
Net returns per bu.		— .14		— .33		— .12		— .11
Returns to labor per acre		1.48		—10.02		19.09		3.53
Returns per da. of labor		.18		— .89		1.69		.35
No. of farms growing		58		58		59		58
Total acres of beans		217		174		180		190
Yield in bu. per acre		50		64		65		59

Cotton

Cotton was grown on almost every farm; but, in general, truck crops were far more important. Cotton was usually neglected for truck crops. In terms of cash receipts and total acres, cotton was the third most important cash crop grown, ranking below cabbage and tomatoes in both respects. On some farms, cotton was grown as a second crop following truck, but this was not the general practice. Corn was the usual crop to follow truck. Deltapine 11 was the most common variety of cotton grown.

The average of the farms surveyed showed that an acre of cotton required 123 man hours, 54 horse hours, 295 pounds of fertilizer, and approximately 1 bushel of seed (Table 22). The average cost of producing an acre of cotton was $29.40, ranging from $29.54 in 1939 to $31.31 in 1938. Man labor was the most important item of expense. Man labor represented 42 percent of the total cost of production, fertilizer 16 percent, rent 12 percent, ginning 10 percent, and horse labor 9 percent.

The sales of cotton and cotton seed per acre amounted to $34.66 and ranged from $39.32 in 1938 to $30.41 in 1940. The net returns per acre amounted to $8.01 in 1938, $1.33 in 1939, $4.39 in 1940, and averaged $5.26 for the three years. The returns to labor per acre were $17.61, ranging from $21.40 in 1938 to $13.23 in 1939. Returns per day of labor amounted to $1.60 in 1938, $1.11 in 1939, $1.40 in 1940, and averaged $1.43 for the three years.

Table 22. Average Inputs, Cost and Returns per Acre of Cotton, Copiah County, Mississippi, 1938-1940

Item	1938 Inputs	1938 Cost	1939 Inputs	1939 Cost	1940 Inputs	1940 Cost	Average Inputs	Average Cost
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Man labor, hrs.	134	13.40	119	11.90	110	11.00	123	12.35
Fertilizer	320	4.39	344	5.31	205	2.82	295	4.20
Rent		3.57		3.84		3.68		3.67
Ginning		3.51		2.67		2.22		2.94
Horse labor, hrs.	56	2.80	54	2.70	51	2.55	54	2.70
Equipment expense		.95		.86		.96		.93
Truck expense		.85		.81		1.07		.90
Seed, lbs.	33	1.00	29	.66	30	.88	31	.88
Interest		.84		.79		.84		.83
Total cost		31.31		29.54		26.02		29.40
Value of cotton per acre		39.32		30.87		30.41		34.66
Cost of cotton per acre		31.31		29.54		26.02		29.40
Net returns per acre		8.01		1.33		4.39		5.26
Returns to labor per a.		21.40		13.23		15.39		17.61
Returns per day of labor		1.60		1.11		1.40		1.43
No. of farms growing		66		64		65		65
Total acres of cotton		815		460		482		586
Yield in pounds of lint cotton per acre		366		279		272		317

Comparison of the Crops Studied

Several measures may be used to determine the profitableness of a crop. The measures used in this study were: (1) net returns per acre; (2) return to labor per acre; and (3) return per day of labor. Net return per acre is the measure most commonly used and is the amount left after all expenses, both cash and non-cash, have been subtracted from the cash receipts. Returns to labor per acre is the cash receipts minus all expenses except labor, and the return per day of labor is the return to labor per acre divided by the days worked per acre.

Cotton was the most profitable crop and cabbage was the most profitable truck crop grown during the last three years. Cotton averaged a net return of $5.26 per acre, cabbage $2.16 per acre, peas minus $4.84 per acre, beans minus $6.60 per acre, and tomatoes minus $14.26 per acre (Figure 8). Although cotton averaged the highest net returns per acre for the three years, it was exceeded in net returns by some other crop in each of the years. Peas had the highest net returns per acre in 1938, cabbage in 1939, and beans in 1940. Cotton ranked second in each of these years.

Returns to labor per acre is the measure of profit that should probably be used when the farmer uses his own or family labor altogether. It represents what the farmer receives for the work performed in making the crop. Peas and beans in 1939 and peas in 1940 were the only crops for which the farmers failed to receive any compensation for their labor. Peas in 1938, cabbage in 1939, and beans in 1940 had the highest returns to labor per acre. During the three years studied, returns to labor per acre were $17.61 for cotton, $13.62 for cabbage, $8.01 for peas, $4.92 for tomatoes and $3.53 for beans (Figure 9).

Returns to labor per day is the measure of profit that should probably be used where one crop requires considerably more labor than another. One can readily see that if a farmer has a limited acreage he will grow the crops that return the most per acre; but if his labor is limited, he will grow the crop that returns the most per day worked. The highest returns to labor per day were $2.59 for peas in 1938, $1.76 for cabbage in 1939, and $1.69 for beans in 1940 (Figure 10). Cotton was the only crop to have returns to labor per day of over $1.00 in each of the years studied, being $1.60 in 1938, $1.11 in 1939, and

$1.40 in 1940. The average returns to labor per day for the three years studied were: cotton $1.43, cabbage $1.18, peas $0.66, beans $0.35, and tomatoes $0.26.

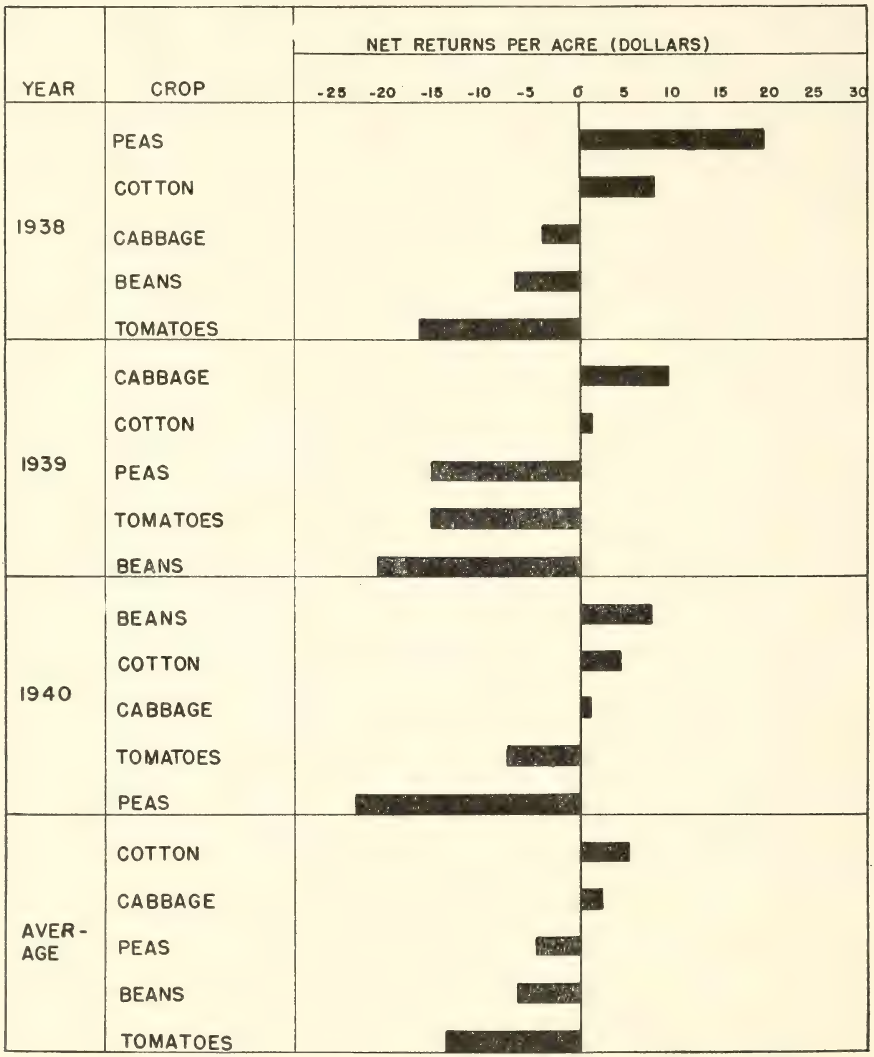

Figure 8. Net returns per acre for important crops, Copiah County, Mississippi, 1938-1940

It is evident that during the period studied, the farmers could not hire much labor and make a profit on truck crops. Cotton and cabbage were the only crops for which farmers could hire all labor and yet make a profit. The fact that there was a wide variation in returns per acre from year to year, and that a different crop was most profitable in each of the years studied probably explains why farmers continue to plant a given truck crop even though they might have lost money on it several years in succession.

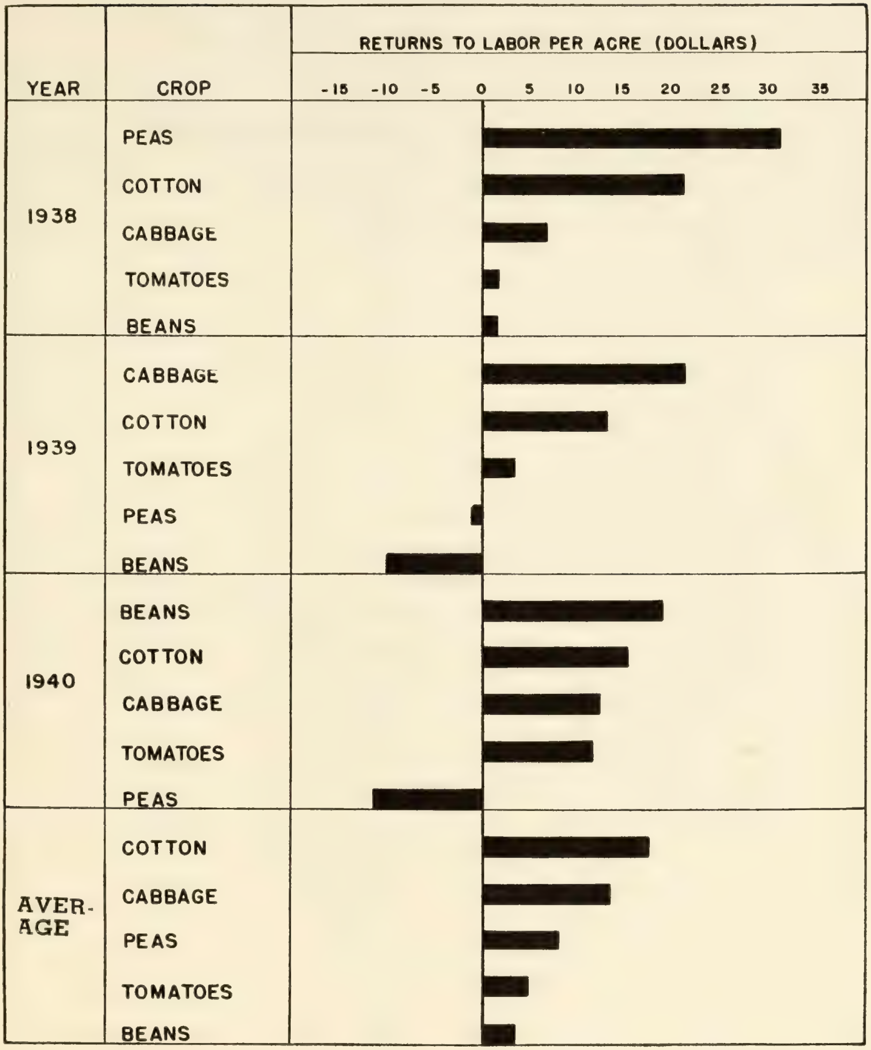

Figure 9. Returns to labor per acre for important crops, Copiah County, Mississippi, 1938-1940

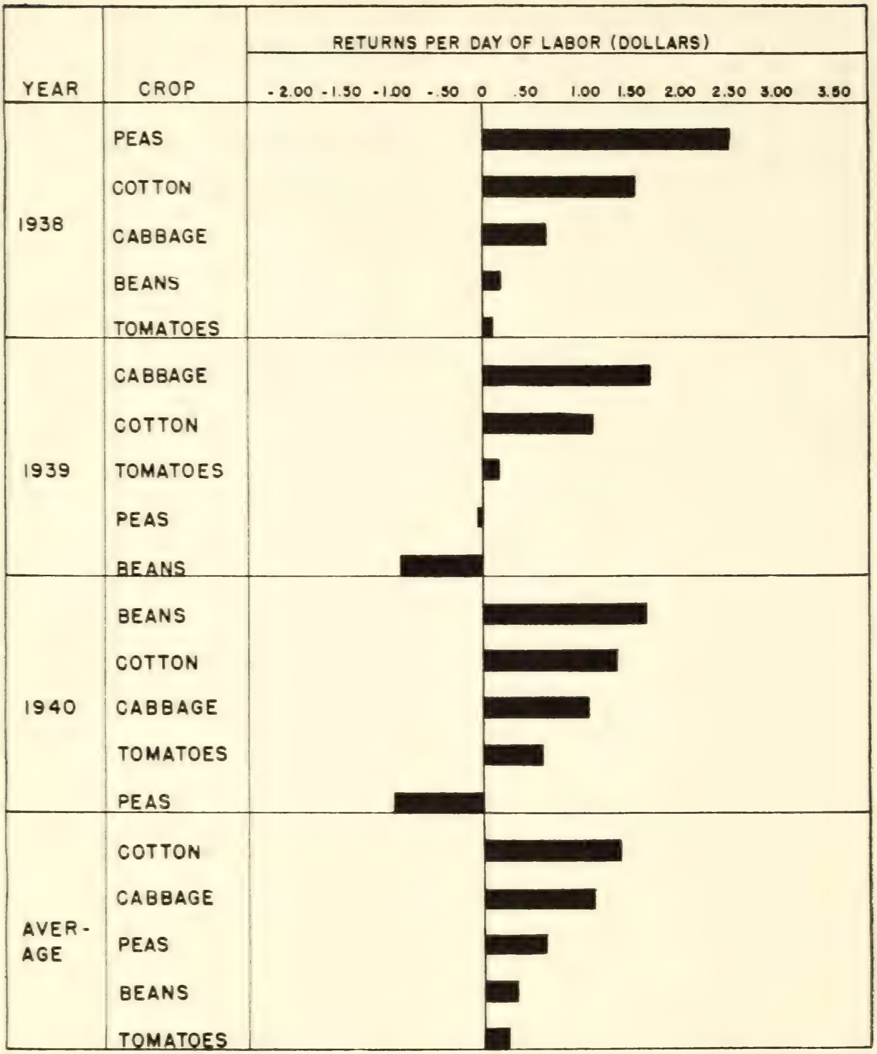

Figure 10. Returns per day of labor for important crops, Copiah County, Mississippi, 1938-1940

AGRICULTURAL CREDIT IN COPIAH COUNTY

Long Term

Fifty-six percent of the farm owners in 1938, 58 percent in 1939, and 55 percent in 1940, had mortgages against their farms, which averaged $2,541, $1,900, and $1,770, respectively, per farm mortgaged (Table 23). Taking all farms operated by owners into consideration, the average mortgage indebtedness per farm was $1,424 in 1938, $1,101 in 1939, and $935 in 1940. The farm mortgage debt on all farms operated by owners amounted to 31 percent of the total value of land and buildings in 1938, 29 percent in 1939, and 26 percent in 1940. This seems to indicate that the farmers were meeting their long-term obligations as they came due, even though the past three years have been unfavorable to truck farming. Eighty-nine percent of the total mortgage indebtedness was held by the Federal Land Bank in 1938, 86 percent in 1939, and 68 percent in 1940. Local banks and individuals were the next two most important sources of long-term credit. The Federal Land Bank charged 4.5 percent interest on money loaned; whereas, the local banks and individuals charged from 6 to 8 percent.

Since the major portion of the long term credit is secured from the Federal Land Bank, this type of credit is on a rather sound basis. To use credit wisely the truck grower should have a definite financial plan adapted to the amount of property owned and cash income. This plan might better err on the side of conservatism and should allow for emergencies. A study of the general economic cycle will help in the intelligent selection of a financing agency with an eye to emergencies. The fundamental feature of any financial plan is the proper balance between income and expense.

Short Term

Eighty-one percent of the farmers in 1938, 80 percent in 1939, and 71 percent in 1940, used short term credit, which averaged $801, $754, and $847, respectively per farm using credit. Taking all farms into consideration, the average amount of short term credit used per farm was $651 in 1938, $603 in 1939 and $604 in 1940 (Table 24). The Truck Growers' Association was the most important source of short term credit used the first two years, constituting 32 percent of the total short term credit in 1938 and 44 percent in 1939. Local stores were the most important source in 1940, making up 32 percent of the short term credit. The Jackson Production Credit Association, local banks, and the Farm Security Administration were other sources of short term credit. The rate of interest charged by the Production Credit Association was 5 percent for the actual time used. The Truck Growers' Association and local stores increased the price of goods sold to credit purchasers over cash prices. These loans were seldom made for a period of over 6 months, as this is about the length of turnover for truck crops.

Since approximately 54 percent of the farmers using credit used store or dealer credit, it is evident that great savings could be brought about by their getting in a position to pay cash and receive a discount or by shifting to less expensive sources of credit such as the Production Credit Association. Merchant credit costs farmers more because merchants charge higher prices for credit purchases than for cash purchases to cover interest and other service charges. These additional costs are due to interest on funds tied up in accounts, added bookkeeping costs, and losses on bad debts.

Table 23. Long Term Credit, Copiah County, Mississippi, 1938-1940

Source of Credit	1938			1939			1940		
	Farms	Total indebtedness	Average indebtedness per farm	Farms	Total indebtedness	Average indebtedness per farm	Farms	Total indebtedness	Average indebtedness per farm
	Number	Dollars	Dollars	Number	Dollars	Dollars	Number	Dollars	Dollars
Federal Land Bank	33	83,300	2,524	33	65,150	1,974	29	44,455	1,533
Local banks	3	10,180	3,393	4	6,930	1,733	3	13,000	4,333
Individuals	1	500	500	3	3,900	1,300	3	1,125	375
Other	0	—	—	0	—	—	2	6,900	3,450
All farms mortgaged	37	93,980	2,540	40	75,980	1,900	37	65,480	1,770
Farms with no mortgage	29	—	—	29	—	—	33	—	—
All farms[1]	66	93,980	1,424	69	75,980	1,101	70	65,480	935

[1] Includes only farm owners.

Table 24. Short Term Credit, Copiah County, Mississippi, 1938-1940

Source of Credit	1938			1939			1940		
	Farms	Total amount of credit	Average credit used per farm	Farms	Total amount of credit	Average credit used per farm	Farms	Total amount of credit	Average credit used per farm
	Number	Dollars	Dollars	Number	Dollars	Dollars	Number	Dollars	Dollars
Truck Growers' Assn.	21	16,900	805	20	21,306	1,065	13	13,000	1,000
Jackson Production Credit Association	18	16,166	898	12	6,932	578	12	14,455	1,205
Local stores	11	12,655	1,150	19	14,720	775	16	15,540	971
Local banks	9	4,825	536	8	3,925	491	8	3,650	456
Farm Security Adm.	4	942	236	5	1,377	275	5	1,198	240
Other	2	585	293	0	—	—	3	450	150
All farms using credit	65	52,073	801	64	48,260	754	57	48,293	847
Farms using no credit	15	—	—	16	—	—	23	—	—
All farms	80	52,073	651	80	48,260	603	80	48,293	604

APPENDIX

Table 25. Carlot Shipments of Vegetables from Copiah County with Comparisons to Mississippi Carlot Shipments, 1931-1940[1]

Year	Tomatoes	Cabbage	Mixed Vegetables	Beans[2]	Peas	Peppers	Others[3]	Total
1931	1,935	1,047	591	65	257	2	19	3,916
1932	2,080	615	448	100	29	3	11	3,286
1933	1,767	706	404	24	86	4	2	2,993
1934	2,200	1,512	380	256	156	12	1	4,517
1935	1,776	1,512	345	250	127	19	5	4,034
1936	1,761	1,930	343	317	250	12	9	4,622
1937	1,571	1,827	348	141	230	41	4	4,162
1938	2,157	2,152	230	142	170	27	0	4,878
1939	1,531	2,111	214	135	90	20	1	4,102
1940	751	1,253	112	43	20	5	0	2,184
Average, 1931-40	1,753	1,466	342	147	142	14	5	3,869
Miss. Shipments Average, 1931-40	2,355	1,708	512	237	151	15	549	5,527
Per cent Copiah Shipments are of Miss. Shipments	74	86	67	62	94	93	1	70

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[1] Data obtained from the Market News Service, United States Department of Agriculture, Bureau of Agricultural Economics, Washington, D. C.

[2] Includes snap beans and lima beans.

[3] Includes beets, carrots, corn, cucumbers, greens, onions, potatoes, sweet potatoes, turnips, and rutabagas and spinach.

Table 26. Carlot Shipments of Vegetables by Months from Copiah County, Mississippi, 10-year Average, 1931-1940[1]

Month	Tomatoes	Cabbage	Mixed Vegetables	Beans	Peas	Peppers	Others	Total	Per Cent of Yearly Shipments
January							1	1	[3]
February								0	0
March		[2]	[2]		1		[2]	1	[3]
April		190	58		97			345	8.9
May	151	1,235	228	91	44		1	1,750	45.2
June	1,574	41	47	54	[2]	6	3	1,725	44.6
July	28		8			8	[2]	45	1.2
August			[2]			[2]		[2]	[3]
September				[2]				[2]	[3]
October				2				[2]	[3]
November							[2]	[2]	[3]
December							[2]	[2]	[3]
Total	1,753	1,466	342	147	142	14	5	3,869	100.0
Per Cent of Total Shipments	45.3	37.9	8.8	3.8	3.7	.4	.1	100.0	

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[1] Data obtained from the Market News Service, United States Department of Agriculture, Bureau of Agricultural Economics, Washington, D. C.

[2] Less than one-half car.

[3] Less than .1 per cent.

Table 27. Yearly Average Farm Prices Received by Mississippi Farmers for Important Truck Crops, 1931-1940[1]

Year	Beans (Bu. of 20 lbs.)	Cabbage (Short ton)	Peas (Bu. of 30 lbs.)	Peppers (Bu. of 25 lbs.)	Tomatoes (Bu. of 53 lbs.)
	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
1931	.75	13.50	1.12	.30	1.07
1932	.60	50.00	1.15	.90	1.85
1933	1.10	32.50	.84	.30	1.80
1934	.55	6.10	1.31	.50	.65
1935	.64	22.50	.88	.55	1.10
1936	1.20	10.30	.90	.65	1.15
1937	.90	30.80	1.05	.55	1.40
1938	.67	8.00	1.40	.50	.75
1939	.55	15.50	.75	1.30	.60
1940	1.23	14.40	.85	.80	.65
Average 1931-1940	.82	20.36	1.03	.61	1.10

[1] Data compiled from mimeographed releases of the Crop Reporting Board of the United States Department of Agriculture.

Table 28. The Acreage, Production, and Average Price Received by Producer Per Unit for Important Truck Crops Produced in Mississippi and Competing States[1]

Competing States	Acreage		Production		Average Price Per Unit	
	1939	1940	1939	1940	1939	1940
Beans	(Number)		(1000 bushels)		Dollars	
Alabama	800	800	60	36	.45	1.00
Georgia	3,500	4,200	280	210	.80	1.00
Louisiana	9,200	7,300	506	402	.90	1.15
Mississippi	4,800	4,100	312	226	.55	1.23
South Carolina	7,200	7,200	504	432	.85	.91
Group Total	25,500	23,600	1,662	1,306	.71	1.06
Cabbage			(Tons)			
Alabama	1,200	1,400	6,000	7,000	30.00	22.00
Georgia, South	2,200	2,700	9,700	11,900	20.00	18.50
Louisiana	4,600	4,600	16,600	16,600	20.50	24.00
Mississippi	7,300	7,000	41,600	28,000	15.50	14.40
North Carolina	1,900	2,200	6,600	9,900	15.00	12.00
South Carolina	1,800	2,200	14,400	11,000	38.00	17.00
Virginia	4,200	4,200	18,100	19,600	13.48	16.00
Group Total	23,200	24,300	113,000	104,000	21.78	17.70
Peas			(1000 bushels)			
Alabama	—	—	—	—	—	—
California[2]	33,000	20,700	2,805	1,760	1.15	1.25
Louisiana	1,250	900	62	45	1.25	1.65
Mississippi	2,500	1,600	100	64	.75	.85
South Carolina	4,600	4,000	161	200	.70	.90
Group Total	41,350	27,200	3,128	2,069	.96	1.16
Tomatoes			(1000 bushels)			
Georgia	5,500	6,500	330	520	2.00	.70
Louisiana	3,000	3,300	216	264	1.15	.80
Mississippi	9,000	5,800	900	444	.60	.65
South Carolina	7,000	7,700	350	462	1.85	1.00
Texas[3]	27,200	29,400	1,768	2,205	1.45	.75
Group Total	51,700	52,700	3,564	3,895	1.21	.78

[1] United States Department of Agriculture, Crop Reporting Board, December 18, 1940.

[2] Excluding the Imperial Valley.

[3] Excluding the Lower Valley.

Table 29. Acreage of Important Commercial Truck Crops in Mississippi, 1931-1940[1]

Year	Beans	Cabbage	Peas	Peppers	Tomatoes
1931	5,200	3,100	2,350	100	9,600
1932	5,900	2,900	1,800	160	9,500
1933	3,600	3,500	2,100	240	10,300
1934	4,550	5,800	1,720	150	12,000
1935	5,950	5,800	1,800	150	9,750
1936	5,250	6,600	2,500	200	9,800
1937	7,050	6,400	3,000	250	9,500
1938	5,000	6,900	2,700	200	10,000
1939	4,800	7,300	2,500	200	9,000
1940	4,100	7,000	1,600	200	5,800
Average 1931-1940	5,037	5,530	2,207	185	9,525

[1] United States Department of Agriculture, Crops and Markets (December issue), 1931-1940.

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Bulletin No. 362 September, 1941

Conserving Minerals and Vitamins in Vegetables

By

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PRACTICAL APPLICATIONS

It is evident from the information which has been presented that vegetables may be so handled and prepared for eating that much of their nutritive value is lost. Thus, the most nutritious parts of certain vegetables may be thrown away. Through improper handling the vitamin C content of fresh vegetables may be considerably reduced before they are cooked, and the destruction or loss of vitamin C may be almost complete by the time they are eaten. Vitamin B_1 may be destroyed by the use of alkali, and much of it may be lost in the cooking water; half or more of the minerals in green vegetables may be discarded with the cooking water. It is very important, therefore, that certain general rules should be followed in the preparation of vegetables if one wishes to conserve their minerals and vitamins.

The following recommended practices are based upon the information which has been given:

Use green vegetables as soon as possible after they have been gathered.

Store green vegetables in a cool, damp place, preferably in a closed container in the refrigerator. Avoid wilting.

Do not throw away the most nutritious parts of vegetables, as the green outside leaves of head lettuce and cabbage.

Use a small amount of water in cooking all vegetables, except the strong-flavored ones.

Never use soda in cooking green vegetables.

Avoid cooking vegetables (except for canning) in ways that employ high temperatures, as frying and cooking in the pressure cooker. Such methods conserve minerals but destroy vitamins.

Cook vegetables as quickly as possible. Whenever vegetables or the water in which they are cooked are to be used in stews and soup, add them toward the end of the cooking period.

In blanching vegetables for canning or freezing, keep the water boiling and blanch them as quickly as possible.

Do not allow cooked or reheated canned vegetables to stand. Serve them as soon as possible. Left-overs should be stored in the refrigerator in covered containers.

Use the water in which vegetables have been cooked or canned.

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CONSERVING MINERALS AND VITAMINS IN VEGETABLES

By OLIVE SHEETS, Home Economics Department

The proper preparation of food has a most important place in our programs for adequate nutrition in national defense. It is essential not only that the housewife should know how to plan an adequate diet for her family, and to serve palatable food, but also that she should know how to prepare it so that it loses a minimum of the nutrients it originally contained. The lower the income, the more this knowledge is needed, for the lower the income, the more limited the amount and kinds of food which can be purchased.

Even with the best food selection, the diet of low income families is not apt to supply any more than is actually necessary of some of the food essentials. An adequate diet may be made inadequate through methods used in food preparation. Two instances of an outbreak of scurvy, a disease due to lack of vitamin C, are given in the 1931 Report on Vitamins of the British Medical Research Council. The outbreaks occurred on diets which should have contained more than adequate amounts of this vitamin, had the vegetables included in the diet been properly prepared. However, they were cooked in meat stews for so long that most of the vitamin C was destroyed.

It is evident, therefore, that dietary calculations based upon the fresh uncooked food may greatly overestimate the vitamin C content of the food as it is actually eaten. This is true to a less extent of other vitamins and of minerals.

No class of foods suffers greater losses of their nutrients through poor preparation than do fresh vegetables. Yet we rely on these foods to furnish an important share of the minerals and vitamins needed in the diet.

It is the purpose of this bulletin to describe the effects of different methods of preparing, cooking and preserving vegetables on the losses of minerals and vitamins. We shall then be in a position to decide what methods to recommend. The term "preparation" will include handling and getting the vegetables ready for cooking or eating raw. The term "preserving" will include canning, freezing and drying.

LOSSES OF MINERALS IN VEGETABLES

Minerals are lost from vegetables by discarding parts of the vegetables or discarding the water in which they are cooked, since minerals dissolve into the cooking water. From a practical standpoint we need concern ourselves only with minerals which are not always supplied in the diet in sufficient amounts, particularly in the diet of low income families. These minerals are iron, calcium and phosphorus.

Losses in Preparation of Vegetables

Losses of minerals result from the preparation of vegetables, because edible parts are discarded, and because the vegetables are frequently peeled or cut into pieces. It is a common practice to discard certain parts of vegetables, such as the outside green leaves of head lettuce and cabbage, the stems and midribs of leafy vegetables, the green leaves and stalks of celery, the peelings, etc.

The green portions of vegetables are particularly rich in calcium and iron, the green leaves having a much higher calcium and iron content than the bleached leaves. On the other hand, the stems and midribs of leaves contain much less iron, less phosphorus and a lower vitamin content than the leafy portion. They also require longer cooking than the leafy portion, and longer cooking causes greater losses of nutrients. For these reasons it may be justifiable to discard the stems and midribs of leafy vegetables when ample quantities are available.

In a study made by the Department of Home Economics of the Mississippi Experiment Station on methods used by Mississippi housewives for preparing and cooking vegetables, it was found that the majority of the women did not use the stems and midribs of leafy vegetables, unless they were young and tender. Peelings are usually thrown away, although analyses of different parts of Irish potatoes have shown that the skin and the layer under the skin have a higher mineral content than the inner portions of the potato.

Vegetables which have been peeled lose more minerals in boiling than those left whole, and large losses occur when vegetables are cut into small pieces.

Losses in Cooking Vegetables

The losses of minerals resulting from the cooking of vegetables depend upon the methods used. Vegetables may be boiled, steamed, cooked in the pressure cooker, baked, or fried. It is obvious that no minerals are lost in baking, and there is little or no loss in frying, so these methods need not be considered in a discussion of losses of minerals in cooking.

The most common method of cooking vegetables is boiling them, but in general practice the amount of water used and the time of cooking vary. In the study of methods of cooking vegetables used by Mississippi housewives referred to above, it was found that the most usual method of cooking was boiling in at least enough water to cover the vegetable, although the majority cooked mustard in less than enough water to cover it. The time of cooking depended upon the vegetable. Mustard and English peas were cooked an hour or more by 60 percent of the 124 women interviewed; cowpeas (field peas) and butter beans were cooked 1½ hours or more, and string beans were cooked 2 hours or more by 80 percent of the women. Turnip tops and collards were cooked 2 hours or more by 50 and 63 percent of the women. Thus, relatively long cooking periods in at least enough water to cover the vegetables were used by the majority of Mississippi housewives in boiling vegetables. Although this study was made some years ago, and cooking methods have improved as a result of education, recent inquiries have disclosed that many women still boil their vegetables for a relatively long time.

Losses of Iron

Iron is an essential part of the hemoglobin, or red coloring matter in the blood, which carries oxygen to the tissues. It is also necessary for the functioning of living cells. Leafy vegetables have a high iron content and the legumes, as peas and beans, are good sources of iron. They contain less iron than leafy vegetables, but more of their iron is available to the body than that which is present in leafy vegetables.

In order to determine the effect of different methods of cooking vegetables on losses of iron, this Department carried out a study in which common southern vegetables of high iron content were cooked. The vegetables selected for study were turnip tops, mustard, collards, string beans, field peas, English peas, and butter beans.

The same general methods of preparation were used in this study as those employed by the Mississippi housewives. The majority of the women did not steam their vegetables, but steaming and cooking in the pressure cooker were included in the methods tested. String beans were broken into pieces before cooking. The stems of the leafy vegetables were discarded. Enough of each vegetable was cooked (2/3 to 1 pound) to make four or five servings. Cooking in smaller quantities, as has often been done in experimental work of this kind, might lead to greater losses of iron and the results would therefore be misleading. Five different methods of cooking were used, as follows:

1. Boiling in more than enough water to cover the vegetable 1 to 2½ hours.

2. Boiling in more than enough water to cover the vegetable ½ to 1¼ hours.

3. Boiling in ½ to ¼ enough water to cover the vegetable ½ to 1½ hours.

4. Steaming 1 to 1½ hours.

5. Cooking in a pressure cooker at 10 to 15 pounds pressure 8 to 15 minutes.

The amount of water used and the time of cooking varied with the vegetable. Method 1 gives the longest period of time ordinarily used by the women to cook the vegetables; method 2, the shortest time required to get the vegetable tender. The vegetables were put in boiling water when cooked by the first three methods. After cooking, the vegetables were drained from 3 to 5 minutes. The fresh, and cooked, vegetable and the cooking water were analyzed separately for iron.

The losses of iron which resulted when the seven vegetables were cooked by the different methods are shown in table 1. The greatest losses occurred in all seven vegetables when they were boiled the longest period of time in the largest quantity of water. Collards, string beans and field peas lost from 25 to 29 percent of their iron when cooked in this way. The loss varied in different vegetables from 9 to 29 percent, mustard losing the least iron. The average loss of iron for the seven vegetables was 20.5 percent, or one fifth of the iron which was present.

When the vegetables were boiled in the same quantity of water as that used in method 1, but a shorter time (method 2), they lost less iron in every instance. The average loss of iron for the second method of cooking was 16.6 percent. Vegetables boiled by the third method, that is, those boiled in the smallest amount of water the shortest time lost an average of only 9.8 percent of their iron, or less than half as much iron as when boiled by the first method. The smallest losses of iron resulted from steaming or cooking in the pressure cooker. An average of 6.9 percent of the iron was lost when the vegetables were steamed and an average of 5 percent when cooked in the pressure cooker. Thus, steaming and cooking in the pressure cooker resulted in the loss of only one third and one fourth as much iron as boiling by the first method.

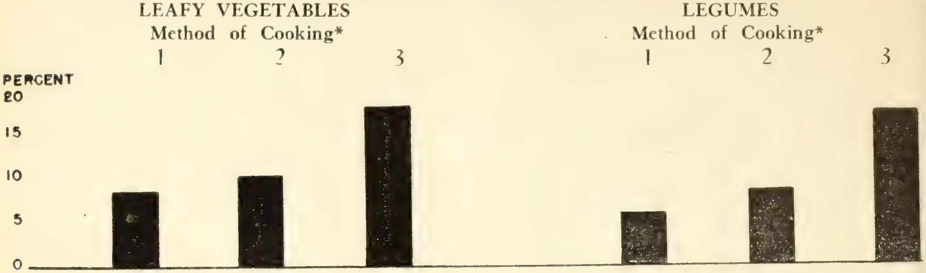
Graph 1 shows the comparative losses of iron which resulted when the leafy vegetables and the legumes were cooked in three different ways. The legumes included field peas, butter beans, and English peas; but did not include string

TABLE 1.—Comparison of the Losses of Iron by Different Methods of Cooking*

Vegetable	(1) Boiled in more than enough water to cover, 1 to 2½ hrs.	(2) Boiled in more than enough water to cover, ½ to 1¼ hrs.	(3) Boiled in less than enough water to cover, ½ to 1¼ hrs.	Steamed ½ to 1 1/3 hours	Pressure cooked 8 to 15 min. 10 to 15 lbs.
	Losses of iron by different methods of cooking				
	Percent	Percent	Percent	Percent	Percent
Turnip tops	18.0	16.1	7.3	7.7	4.9
Mustard	9.3	8.8	7.0	6.7	1.2
Collards	29.2	26.2	17.0	10.5	——
Field peas	25.5	21.6	10.9	7.4	——
English peas	13.1	10.8	8.0	5.0	7.3
Butter beans	19.2	11.7	6.2	4.2	4.9
String beans	29.0	21.3	12.2	6.7	6.8
Average	20.5	16.6	9.8	6.9	5.0

*(1) and (2) boiled in 1½ c. to 1 qt. of water; (3) boiled in 3/4 c. to 1½ c. of water.

Graph 1.—Average losses of Iron in Cooking Vegetables by Different Methods.



*Method 1, Steaming; method 2, boiling in less than enough water to cover vegetables ½ to 1¼ hours; method 3, boiling in more than enough water to cover vegetables 1 to 2½ hours.

beans, since they are pods, not seeds. As might be expected, the seeds lost less iron than the leafy vegetables for all three methods of cooking, although the difference was small for the method which caused the largest losses of iron.

In general the results obtained by us on losses of iron by the different methods of cooking correspond with those reported by other investigators. Thus, all have found that the amount of water used and the length of time the vegetables are cooked affect the losses of iron, and that the losses increase when the quantity of water and the cooking time are increased. Other workers have also found that steaming and cooking in the pressure cooker caused the smallest losses. If, however, conditions are such within the steamer that water washes down over the vegetables, or the vegetables in the pressure cooker are surrounded with water, large losses of iron may occur.

Peterson and Hoppert reported losses for iron in 16 different vegetables boiled in two ways, steamed and cooked in the pressure cooker. The vegetables included asparagus, string beans, beet greens, cabbage, cauliflower, celery, celery cabbage, spinach, beets, carrots, kohlrabi, onions, parsnips, Irish potatoes, sweet potatoes and rutabagas. The vegetables were cut in small pieces and about 1 to 1½ pounds of each vegetable were cooked. They were boiled in just enough water to cover them, and in twice that amount of water, for about 30 minutes; steamed 40 minutes, and pressure cooked 15 minutes at 15 pounds pressure. The losses of iron varied greatly for different vegetables, but were largest when the vegetables were boiled in the most water; and least when they were steamed or cooked in the pressure cooker. The losses for leafy vegetables were greater than those for roots, tubers and bulbs. Table 2 shows the losses of iron for four of the vegetables.

Peterson and Hoppert reported much larger losses for iron in leafy vegtables than we found. The losses for string beans, except for steaming, are more comparable to ours. The differences in results are doubtless due chiefly to the fact that Peterson and Hoppert cut their vegetables into small pieces whereas ours were left whole with the exception of string beans. Differences in results may also have been due to differences in the nature and composition of the cooking water. The reaction of the water, that is, whether it is acid or alkaline, and the minerals present in the water, are known to affect losses in cooking. Alkali in the water causes increased losses of nutrients, but the vegetables become tender in a shorter time. In the Mississippi study distilled water which is neutral in reaction, and contains no minerals, was used. Peterson and Hoppert do not state what kind of water was used.

Losses in Calcium and Phosphorus

Calcium and phosphorus are both necessary for the building of bones and teeth. Although the bones and teeth contain over 99 percent of the calcium and about 70 percent of the phosphorus of the body, these two elements are essential in the functioning of many kinds of body tissues. Leafy vegetables, especially those of the cabbage family, contain relatively large amounts of calcium, while the leguminous vegetables have a high phosphorus content.

Peterson and Hoppert also determined losses of calcium and phosphorus in the sixteen vegetables which they cooked. The results for four of the vegetables are shown in table 2. In most cases the calcium and phosphorus losses were smaller than those for iron; exceptions were cabbage and sweet potatoes. The trend, however, was the same so far as methods of cooking were concerned. That is, the greatest losses took place when the largest amount of water was used, and the smallest losses occurred when the vegetables were steamed or cooked in the pressure cooker. It will be noted that the calcium losses for beet greens were small. The reason for this is that this vegetable contains an insoluble form of calcium. This calcium cannot be used by the body.

The results of Peterson and Hoppert show that some of the leafy vegetables may lose half or even more of their calcium, phosphorus and iron when they are cooked by certain methods.

We see, therefore, that losses of iron, calcium and phosphorus depend upon a variety of factors, chief of which are the kind of vegetable, the amount and kind of water used, the time of cooking and whether the vegetables are cut up or left whole. Since minerals are not destroyed in cooking, it is obvious that they will not be lost if the cooking water or pot liquor is used.

Losses in Preservation of Vegetables

Canning. The same factors which affect losses of minerals in cooking affect

TABLE 2.—Effect of Cooking on Losses of Calcium, Phosphorus and Iron*

Vegetable	Method of cooking	Losses of calcium	Losses of phosphorus	Losses of iron
String beans	Boiled (1)	22.3	21.4	—
	Boiled (2)	29.3	27.6	38.1
	Steamed	16.3	18.8	24.5
	Pressure cooker	6.9	6.2	9.3
Cabbage	Boiled (1)	61.6	45.1	56.4
	Boiled (2)	72.3	59.9	66.6
	Steamed	40.2	22.0	34.6
	Pressure cooker	28.7	19.3	23.1
Beet greens	Boiled (1)	8.6	35.0	45.0
	Boiled (2)	15.9	44.9	43.1
	Steamed	3.8	14.0	24.5
	Pressure cooker	13.9	8.5	8.4
Sweet potatoes	Boiled (1)	35.9	33.7	33.3
	Boiled (2)	38.3	44.4	31.5
	Steamed	22.1	24.3	25.1
	Pressure cooker	16.7	8.7	6.4

(1) Boiled with just enough water to cover vegetable.
(2) Boiled with twice as much water as (1).
*Data from Peterson and Hoppert.

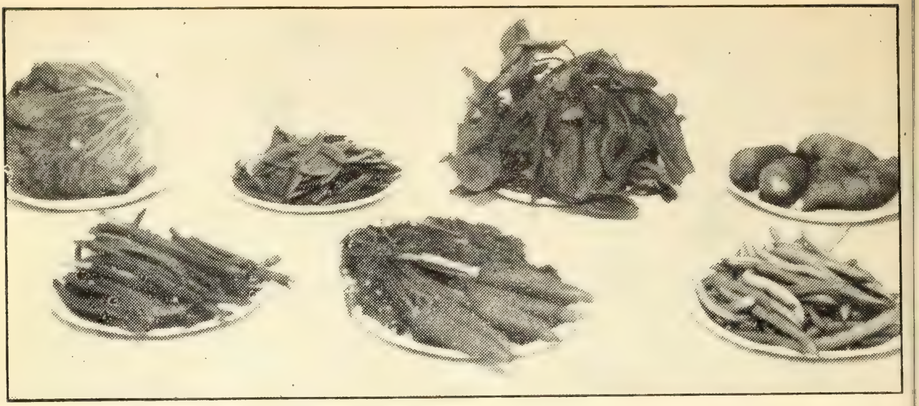


Figure 1.—Good sources of minerals and vitamins.

losses in canning. Certain methods used in canning, however, may cause additional losses. These are: (1) blanching, and (2) processing the vegetables at a higher temperature than is used in ordinary cooking. Blanching is pre-cooking the vegetable in boiling water before it is placed in the can. Since the time of blanching is short, usually from two to ten minutes, mineral losses are not as great as in cooking.

Losses of phosphorus, varying from 3 percent for carrots, to 12 and 20 percent for English peas and to 48 percent for spinach, have been reported. No information was found on losses of iron. Processing of vegetables at a relatively high temperature as in a pressure cooker causes greater breakdown of the vegetable tissue than occurs in boiling and, therefore, greater losses of minerals when they are surrounded by water. The practice of throwing away the liquor in canned vegetables is, therefore, no more justifiable than throwing away the pot liquor in boiled vegetables.

An interesting finding in connection with the cooking and canning of vegetables is that the amount of calcium in the water used affects the amount of calcium in the cooked or canned vegetable. Vegetables which are cooked, blanched or canned in hard water containing calcium, may absorb considerable calcium instead of losing it.

Freezing. All vegetables which are to be quick-frozen are first blanched for two to three minutes. The losses will of course correspond to those in blanching for canned vegetables. There is some breaking down of the vegetable tissue due to freezing which could cause greater losses of minerals in cooking, but this is probably offset by the smaller losses which would result from the shorter cooking time required for quick-frozen vegetables.

Drying. It is obvious that there is no loss of minerals when fresh vegetables are dried. Losses would occur only when the vegetables are cooked. Since the fresh, succulent vegetables are usually cut up before being dried, and since they must be soaked for several hours before cooking, large losses of minerals will occur, especially if they are not cooked in the water in which they are soaked. These are additional reasons for using the cooking water from dried vegetables.

LOSSES OF VITAMINS IN VEGETABLES

The vitamins with which we are chiefly concerned in the preparation of vegetables are vitamins A, B_1 and C. According to our present knowledge, it is these three vitamins which are most affected by the various processes to which vegetables may be subjected from the time of harvesting until they are eaten. Moreover, many southern diets have been found to be deficient in one or more of these vitamins, especially vitamin C. Each of these vitamins will be discussed separately. It may be pointed out in general, however, that the same factors which affect losses of minerals also affect losses of vitamins. In addition, there are other factors which bring about losses of vitamins which have little or no effect on mineral losses. Vitamins are not only lost because they are soluble in the cooking water, but they are also lost through destruction by heat and oxidation.

Vitamin A

Vitamin A is essential to the normal functioning of the body. It is necessary for growth and for reproduction. It aids in the resistance to infections, in the functioning of the glands, and is necessary for normal eyesight. Thus, persons whose diet contains too little vitamin A are apt to suffer from night blindness.

This vitamin does not exist in plants as such. Their vitamin A value is due to a yellow substance called carotene, which is transformed by the body into vitamin A. For this reason the terms "carotene" and "vitamin A" are often used interchangeably in referring to carotene in plants.

The green leafy vegetables, particularly those with thin leaves, as spinach and turnip greens, are very rich in vitamin A. The yellow vegetables are also good sources of it. In green plants, or parts of plants, vitamin A or carotene is associated with greenness. The yellow color is masked by the green chlorophyll. Thus, the inside bleached leaves of head lettuce and cabbage contain very little vitamin A, while the outside green leaves are rich in it, as has been pointed out in a previous article.* In preparing these and other vegetables, as cauliflower and celery, we should not, therefore, throw away edible green parts.

Losses in Cooking

Both vitamin A and carotene are nearly insoluble in water, but are soluble in fats and oils. That is, they will dissolve only slightly in water, but will dissolve in fats and oils. Consequently, they will not be dissolved to any extent in the cooking water unless it contains fat. Also, they are not destroyed by high temperatures if oxygen is not present, but may be destroyed by oxidation. Ordinary cooking will, therefore, cause little loss of vitamin A. Some destruction has been reported when vegetables were boiled as long as an hour. It is probable that slow cooking of green vegetables with fat for two to three hours may cause considerable loss of vitamin A. Some of the vitamin A will be in the cooking water and some will have been destroyed.

Losses in Preservation

Canning. Destruction of vitamin A in vegetables does not take place to any extent in blanching and canning because there is little opportunity for oxidation to occur. In processing, all or a part of the air is excluded. For this reason, canned green or yellow vegetables may be better sources of vitamin A than the cooked vegetables.

Freezing. The processes used in freezing also have little effect on the vitamin A content of vegetables. Zimmerman, Tressler and Maynard found that the freezing of broccoli, spinach, lima beans and asparagus resulted in no loss of their vitamin A value. Storage of the frozen vegetables at 40 degrees for five months also led to no loss of vitamin A.

Drying. This is the least desirable

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*Sheets, O. Green Vegetables Superior to Those Bleached in Content of Calcium and Iron, and Vitamins A and C. Mississippi Farm Research. Vol. 4, p. 8.

method of preserving vegetables from the standpoint of vitamin A losses, because of the opportunity for destruction through oxidation. Very little information exists on losses of vitamin A in dried vegetables, but it has been found that dried grasses and dried fruits may have lost half or more of their vitamin A value in a few months' time. In spite of such large losses, leafy vegetables are so rich in vitamin A that they would still be good sources of it. The extent of vitamin A losses will depend upon the temperature and time of drying and storage. Drying at a relatively high temperature, which shortens the time of drying and destroys oxidative substances in the plant, and storing at low temperatures, decrease the loss of vitamin A.

Vitamin B_1

Vitamin B_1, like vitamin A, is an essential constituent of the diet. It also is necessary for growth and for reproduction. It stimulates the appetite and aids in digestion. It is necessary for the normal functioning of the nerves. When this vitamin is almost completely lacking, a disease called "beri-beri" develops, which causes wasting and paralysis. Beriberi is common in the Orient, but not in this country, although many American diets contain insufficient amounts of vitamin B_1.

Vitamin B_1 is soluble in water and exists in plants in a form which is easily extracted by water. It is destroyed by heat in the presence of an alkali, as soda, but not in the presence of acid except at high temperatures.

Like most other foods, vegetables do not have a high vitamin B_1 content, but are important sources of it in the diet because we eat them in fairly large amounts. The seed vegetables, such as cowpeas, soybeans and butter beans, are an exception, for they are rich in vitamin B_1, especially soybeans.

Losses in Cooking

Vegetables may be boiled for an hour or longer without destroying more than 10 to 15 percent of their vitamin B_1 content, provided soda has not been added. The addition of soda, however, may cause very extensive destruction of vitamin B_1. Cooking losses in the absence of alkali are brought about mainly by the solution of vitamin B_1 in the cooking water. Half of the vitamin B_1 content of spinach was found to have dissolved out into the cooking water when it was boiled 15 minutes. Other leafy vegetables could be expected to lose comparable amounts. Cutting the vegetables into pieces would increase the cooking losses of vitamin B_1 as it is soluble in water.

Since the seed vegetables, that is, the legumes, are among the few rich sources of vitamin B_1, and since they are an important class of foods, information on the losses of vitamin B_1 in cooking these vegetables is of particular value. Studies have been reported by Kelly and Porter, Aughey and Daniel, and Lantz on cooking losses of vitamin B_1 in several varieties of beans, including two varieties of common bush shell beans, navy beans, and pinto beans.

The two varieties of shell beans and the navy beans did not lose any of their vitamin B_1 content as the result of the cooking processes used, which included soaking, boiling and baking. There was some reduction in the vitamin B_1 content of pinto beans, especially when boiled for a long time in alkaline tap water. Pinto beans boiled six hours were, however, still an excellent source of vitamin B_1. Cooking with soda at high temperatures was found to be very destructive of vitamin B_1.

Losses in Preservation

Canning. The losses of vitamin B_1 in canning are not due to its destruction, but to its solution. The water used in blanching and the liquor surrounding the vegetable in the can extract the vitamin. It is probable that loss of vitamin

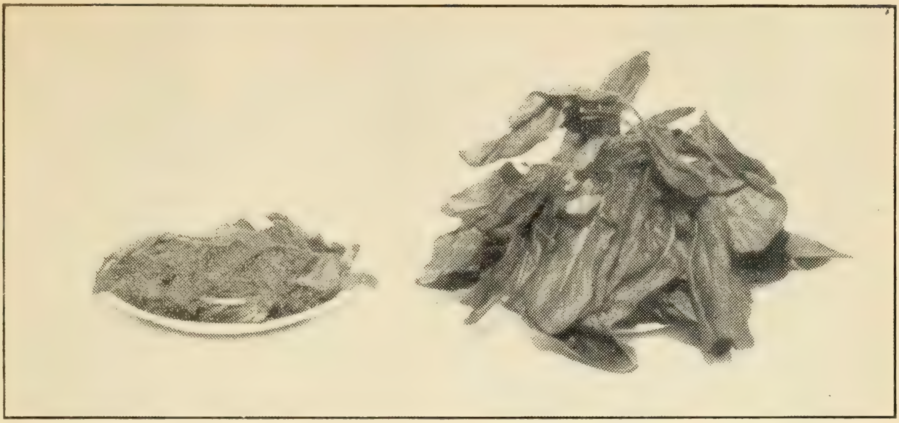

Figure 2.—The spinach on the left was allowed to wilt in a warm room and has lost most of its vitamin C. The spinach on the right was kept fresh in the refrigerator and has retained most of its vitamin C.

B_1 occurs during storage of canned vegetables, but there is very little information on this subject.

Freezing. Vitamin B_1 is not affected by the quick-freezing of vegetables, but blanching may cause considerable loss of this vitamin in those vegetables which show a tendency to lose it in cooking. Lima beans and broccoli lost about 50 percent, and asparagus and peas 25 percent of their vitamin B_1 content after they had been frozen.

Drying. Little is known about the effect of drying on vitamin B_1 in foods, Drying at low temperatures seems to cause little destruction, but at high temperatures the destruction is probably much greater.

Vitamin C

Vitamin C stimulates growth. It is essential for functioning of the glands and other tissues of the body. It favors the development of good teeth and is necessary for healthy gums.

Vitamin C is known as the anti-scorbutic vitamin, because when it is lacking in the diet the disease, scurvy, develops. Soldiers and sailors formerly suffered greatly and many died from this disease because their diet contained no fruits or vegetables. At the present time, scurvy is seldom seen in this country, but many persons consume diets which contain too little vitamin C for good health.

It has been stated that if vitamin C is retained in vegetables, all other nutrients will be retained because vitamin C is the most easily destroyed of all the vitamins. Moreover, no other nutrient, including minerals, is more easily dissolved.

Vitamin C is destroyed by oxidation when foods containing it are exposed to the air. Substances called oxidases, which occur in plants, assist in this process of oxidation. Destruction of vitamin C goes on more rapidly as the temperature increases. Fortunately, the oxidases themselves are quickly destroyed by the boiling temperature.

All fresh vegetables contain vitamin C, but certain vegetables are especially good sources of it. Peppers are particularly rich in this vitamin. Cabbage and other members of the cabbage family, as kale and cauliflower; also turnip greens, mustard greens and other leafy vegetables contain large amounts of it. The tomato, an excellent source of vitamin C, is used as a vegetable, but in reality is a fruit.

Losses in Storage and Preparation

The destruction of vitamin C begins as soon as vegetables are harvested. The rapidity of this destruction depends upon the type of the vegetable and the temperature. Non-acid vegetables and those with thin leaves lose vitamin C more rapidly than other kinds of vegetables. Refrigeration decreases the rate of destruction of vitamin C. Spinach was found to lose half of its vitamin C when left at room temperature for three days, but when stored in the refrigerator at 32-37 degrees F. for the same length of time lost very little. Whole heads of cabbage lost vitamin C slowly when stored, while carrots lost no vitamin C after four months of storage.

The amount of surface exposed by the vegetable, as well as the condition of vegetable tissue, also affects losses of vitamin C. Lima beans left in the pod lost their vitamin C much more slowly than those which were shelled. Any method of preparation which involves grinding, chopping or cutting up the vegetable increases the surface exposed, opens up the plant cells to the air and releases oxidases. This causes a rapid loss of vitamin C, as determined in a number of studies in which vegetables were minced or chopped and allowed to stand at room temperature. Thus, the practice of cutting up vegetables and letting them stand in cold water is not a desirable one from the standpoint of preserving vitamin C.

The question of whether vitamin C could be restored in leafy vegetables which have been allowed to wilt, by refreshing them in cool water was investigated by Mississippi workers.* There was no evidence that vitamin C could be restored in this way.

Losses in Cooking

We have seen that vegetables lose vitamin C in two ways: (1) by destruction of the vitamin, and (2) by its dissolving in water. It has also been stated that the oxidase or enzyme which takes part in this destruction may itself be destroyed by heat. A temperature of 212 degrees F. (boiling temperature) for only one minute will destroy it, but a longer time is needed for the heat to penetrate the vegetable. Studies on cooking losses of vitamins in peas, Swiss chard, carrots and cabbage have shown that most of the destruction of vitamin C takes place in the first two minutes of cooking. However, if vegetables are cooked slowly so that it takes some time for them to reach the boiling point, the enzyme will have a much longer time in which to act and, therefore, will bring about a greater destruction of vitamin C. In boiling, a greater loss of vitamin C is brought about by its solution in the cooking water than by its destruction. From 20 to 66 percent may be lost in this way. The largest losses occurred when the vegetables were shredded.

Baking, steaming, stewing, and frying cause more destruction of vitamin C than boiling because of slow cooking, or high temperatures. In baking and frying the high temperatures are very destructive of vitamin C. Steaming is a slower method of cooking than boiling, but there is very little loss of vitamin C in the water used in steaming. Therefore, the total loss may be less than in boiling. Stewing, because it is a long slow method may bring about almost complete destruction of vitamin C. Therefore, if vegetables are to be added to a stew they should be cooked just long enough to get them tender.

Vitamin C, like vitamin B_1, is destroyed by alkali. This is an additional reason for not using soda in cooking vegetables.

Not only do vegetables lose vitamin C in the process of preparation and cooking, but also after they are cooked if they are kept warm or allowed to stand at room temperature. Even when stored

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*Leonard, O. A., and Sheets, O.

Figure 3.—Steaming is a good way to conserve minerals and vitamins when vegetables are cooked.

in the refrigerator the loss of vitamin C in most cooked vegetables is considerable. Warmed-over vegetables are, therefore, likely to contain very little vitamin C.

Losses in Preservation

Canning. Vegetables usually retain more of their vitamin C when they are canned than when they are cooked by ordinary methods. The principal reasons for this are the blanching of vegetables, which destroys the oxidase, and the removal of air by exhaustion of the cans before they are sealed and processed. Although less vitamin C is destroyed in canning than in ordinary cooking, more vitamin C may go from the vegetable into the liquor when vegetables are canned. The high temperature used in canning breaks down the plant cells, and vitamin C is released.

Acid vegetables lose less vitamin C when canned than non-acid vegetables. It has been reported that tomatoes lost no vitamin C when home canned, either by the cold- or hot-pack method. Care was taken, however, to reduce the head space in the jar to a minimum, for it has been found that the amount of destruction of vitamin C in tomato juice during cooling and storage corresponds to the amount of head space left in the bottle. A great loss of vitamin C occurred during cooling and storage when the bottles were only partially filled with tomato juice. The extent of the loss of vitamin C seemed, therefore, to depend upon the amount of air remaining in the container.

Canned vegetables lose vitamin C slowly, but at varying rates during storage. In the above-mentioned study on home canned tomatoes, from 30 to 50 percent of this vitamin was lost during six months storage. A recent study made by Fellers and Buck on commercially canned vegetables indicates that with improved commercial methods the destruction of vitamin C during storage may be reduced considerably. Three varieties of strained peas, spinach and tomato juice packed in glass containers and stored for one year at room temperature (70-80 degrees F.) lost only 10 to 25 percent of their vitamin C content. Very little loss occurred after the first two or three months of storage, when the disappearance of oxygen from these foods was complete. Storage of the vegetables at 36 degrees F. for one year reduced the loss of vitamin C to less than 5 percent.

Reheating canned vegetables causes further loss of vitamin C, although the loss is probably small unless they are heated too long, or allowed to stand.

Freezing. When properly blanched, the loss of vitamin C in quick-frozen vegetables is small. The vitamin C content of cooked quick-frozen vegetables is about the same as that of the freshly cooked vegetables if the methods of cooking are comparable.

Drying. In general drying is very destructive of vitamin C, although some vegetables seem to retain their vitamin C after they have been dried, better than others. According to several reports, savoy and red cabbage lost 14 to 24 percent; carrots, tomatoes and onions, 40 to 60 percent; and celery, green beans, potatoes, parsley, spinach, and cabbage, 70 to 95 percent of their vitamin C when dried. It is evident from these reports that most dried vegetables would be poor sources of vitamin C.

SUMMARY

Losses of Minerals. Minerals are lost because they dissolve out of the vegetables into the cooking water. They are not destroyed. The loss of iron, calcium, and phosphorus in the cooking of vegetables depends upon the method of cooking, the type and condition of the vegetable, and the kind of water that is used.

The greatest losses of these minerals occurred when the vegetables were cooked the longest time in an excess of water, and the smallest losses when they were steamed or cooked in the pressure cooker. Leafy vegetables lost more of their minerals than seeds, roots, bulbs, or tubers.

Cutting the vegetables into small pieces increases the losses of minerals in cooking.

Calcium losses of vegetables are small when vegetables contain an insoluble form of calcium.

Calcium may be absorbed by vegetables when cooked in hard water containing calcium.

The losses of minerals in canning may be greater than those in ordinary cooking, because of the losses in blanching, and those due to greater breaking down of vegetable tissue in processing.

Mineral losses in the cooking of frozen vegetables are also increased by blanching and the breaking down of the vegetable tissue, but this increased loss is probably offset by the shorter cooking time used for frozen vegetables.

Losses of vitamins. Vitamins A, B_1, and C are the vitamins present in vegetables which are most affected by the processes used in their preparation and preservation.

Vitamin A exists in plants in the form of a yellow substance called carotene, which is transformed by the body into vitamin A. Green leafy vegetables are very rich in carotene, and yellow vegetables are good sources of it.

Carotene and vitamin A are not soluble in water, but are soluble in fats and oils. They are stable towards heat but may be destroyed by oxidation.

Ordinary cooking and canning processes cause little loss or destruction of vitamin A. Long cooking in water containing fat may cause destruction of vitamin A and loss in the cooking water.

Quick-freezing of vegetables does not

result in loss of their vitamin A value. Loss of this vitamin was not observed after several months storage.

Drying is destructive of vitamin A because of the opportunity for oxidation. Leafy vegetables may lose half or more of their vitamin A as a result of drying and still be good sources of it.

Vitamin B_1.—Most vegetables do not have a high vitamin B_1 content. Legumes are an exception as they are rich in this vitamin.

Vitamin B_1 is soluble in water and easily extracted by it when vegetables are cooked in water. It is destroyed by heat in the presence of alkali, as soda, but not in the presence of acids, except at high temperatures.

Cooking and canning processes do not destroy vitamin B_1 to any extent, except in the presence of alkali. Losses are brought about chiefly by the solution of vitamin B_1 in the cooking water. Blanching may cause considerable loss of vitamin B_1.

In the quick-freezing of vegetables vitamin B_1 is lost in the blanching process, but is not affected by freezing.

Vitamin C—All fresh vegetables contain vitamin C. Particularly good sources of it are peppers, vegetables belonging to the cabbage family, and all leafy vegetables and tomatoes.

Vitamin C is more easily destroyed than any of the other vitamins. It is oxidized when foods containing it are exposed to the air. Thus, vegetables begin losing vitamin C as soon as they are harvested. Plants contain an oxidase or oxidizing enzyme which plays an important part in the destruction of vitamin C. This destruction goes on more rapidly as the temperature increases, but the oxidizing enzyme is destroyed by the boiling temperature. When vegetables are put into boiling water, which is kept boiling, the oxidase is quickly destroyed, and the vegetables retain their vitamin C much better than when they are cooked slowly. Slow, long cooking is very destructive of vitamin C. High temperatures above the boiling point are also destructive of this vitamin.

Vitamin C is very soluble in water. In boiling, more vitamin C goes into the cooking water than is destroyed.

Chopping or shredding vegetables greatly increases the loss of vitamin C through oxidation and, if they are cooked, through loss of vitamin C in the cooking water.

Cooked vegetables allowed to stand lose vitamin C. The rate of destruction is highest when they are kept warm, but there is considerable loss in the refrigerator.

Vegetables usually retain more vitamin C when they are canned than when they are cooked, but much of the vitamin may go into the canning liquor.

Acid vegetables lose less vitamin C when cooked or canned than non-acid vegetables.

Canned vegetables lose vitamin C during storage. The loss is related to the head space in the jar and the amount of oxygen remaining in the vegetables. Reheating canned vegetables causes further loss of vitamin C.

Quick-freezing is not destructive of vitamin C. Cooked frozen vegetables and freshly cooked vegetables have about the same vitamin C content when cooked by similar methods.

Drying is very destructive of vitamin C in vegetables. The loss depends upon the method of drying and the kind of vegetable.

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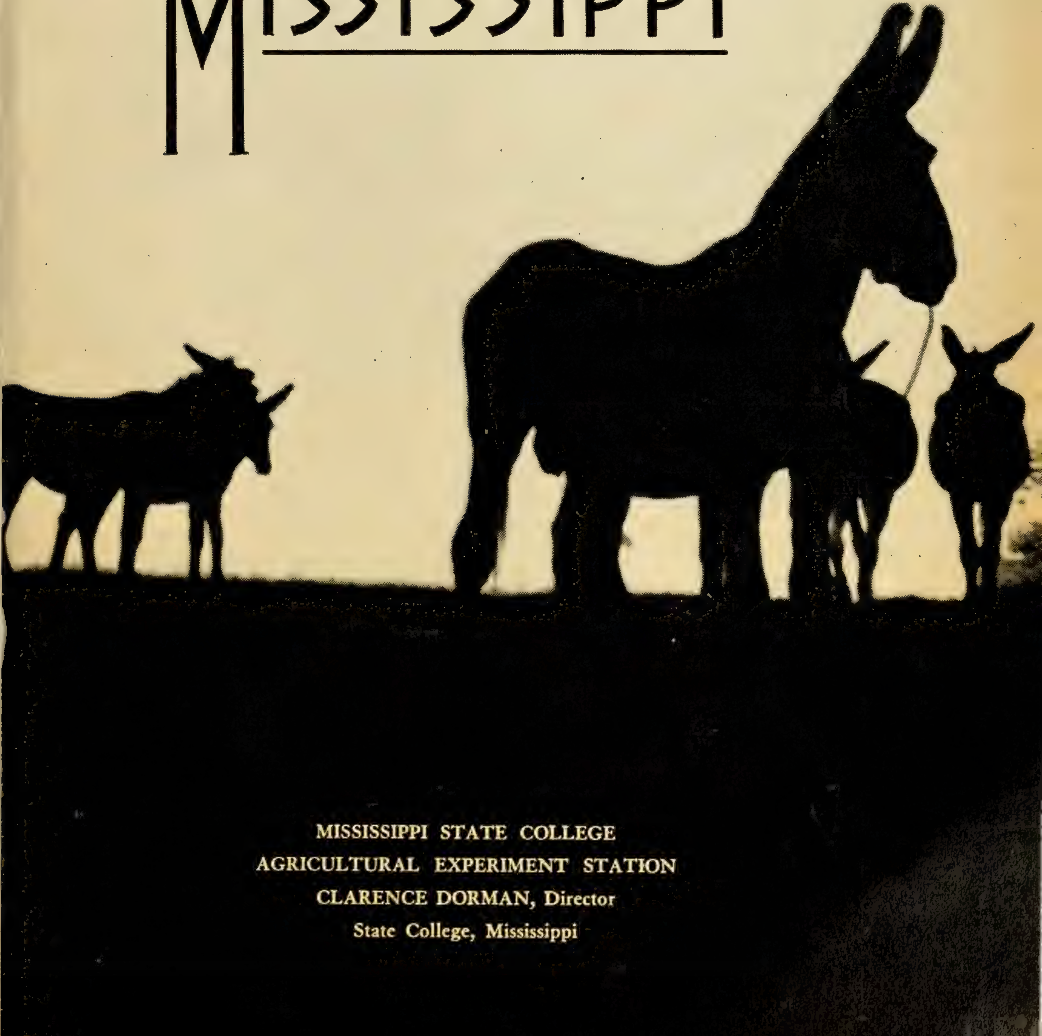
JACKSTOCK PRODUCTION in MISSISSIPPI



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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Jackstock Production In Mississippi

By RAY H. MEANS, Acting Head
Animal Husbandry Department

The jack still plays an important part in Mississippi agriculture, even though a great effort has been made in recent years to replace his offspring, the mule, with mechanical power. As a matter of fact, during the 15-year period from 1925 to 1940, while the number of tractors on Mississippi farms increased from 1871 to 16,703[1], the number of mules also increased from 328,000 to 361,000[2] head.

These figures indicate that Mississippi farmers will continue to need and use large numbers of mules on the 291,000[3] farms regardless of the increased use of tractor units. The average size of farms in Mississippi is only 65.8 acres, and the relatively small cultivated acreage accounts in part at least for the continued demand for mules even though it is true that the tractor has largely replaced the mule for certain types of farm work.

Good mules are the product of good jacks and mares, and census figures show that Mississippi does not produce a sufficient number of mules, jacks or mares for replacements. On account of old age, deaths, and accidents about 25,000 mules are replaced each year in the State. It has been estimated that approximately one-third of the mules required for replacement are produced within the State leaving from 15,000 to 20,000 mules that must be purchased annually from other states. Thus, it is evident that Mississippi farmers are spending from one million dollars to two million dollars each year for replacement mules. This sum represents not only the cost of production of these mules but also transportation, yardage, feed, dealer's profit, and other costs.

It seems likely that a principal reason why more mules are not produced in Mississippi is that not enough good, strong jacks have been available. It also appears that not enough brood mares have been available to produce the mules necessary for replacement purposes, since there were only 87,000[4] head of horses and horse colts in the State January 1, 1940. Census figures do not indicate the number of mares included under this general classification. Breeding records on a large number of mares indicate that approximately 50,000 mares, exclusive of those bred to stallions, would be required to produce, 25,000 mules annually. It is believed, however, that if good jacks were made available in locations throughout the State, the number of brood mares would be increased. Progress has been made in that direction. Since 1935 there has been a considerable increase in the number of jacks available for breeding.

During this period the Farm Security Administration placed in the hands of farmers 127[5] jacks purchased at an average cost of $581.00. This number, together with greatly increased private purchases, probably represents an increase of from 300 to 400 jacks available for mule production in the State during the past six years. It seems likely that the 11,000 head increase in number of mules during the period from 1936 to 1940 may be attributable to the greater number of jacks available. It is of interest that 75 percent of the jacks purchased by the Farm Security Administration were secured from states other than Mississippi.

Thus it can be seen that Mississippi farmers are not only spending a very considerable sum of money annually for replacement mules that are produced in other states, but they are also spending thousands of dollars annually for breeding stock in order to produce even a third of the total number of replacement mules that are required in the State every year. Mule production is therefore of major importance in Mississippi agriculture, and jackstock in sufficient numbers and of sufficient quality, is of major importance in mule production. Meanwhile, there is a scarcity of experimental information on jackstock production.

It was in the light of these facts that in 1936 the Mississippi Experiment Station undertook a study of some of the problems involved in jackstock production and management.

Object

The object of this experiment was to make a study of jackstock production in Mississippi with special emphasis on growth, feed requirements, breeding habits, and miscellaneous care and management.

Plan of Study

This project was started in March 1936, when ten mature registered jennets were purchased by the Mississippi Experiment Station. A registered jack was already on hand for use in this study. The plan was to maintain the jennets in a vigorous condition throughout the year and breed them as they showed signs of heat. When the male and female offspring appeared, weight, measurement, and photographic records were taken at birth and at regular intervals until mature. A record of the kinds and amounts of feed consumed was kept, as well as a record of miscellaneous factors that may influence the normal development of jacks and jennets.

All breeding work with the jackstock was under the supervision of V. R. Berliner, associate in animal husbandry, and records pertaining thereto were supplied by him.

Ten Tennessee-bred Jennets

The ten jennets used as foundation animals in this study were Tennessee bred and raised and were fair representatives of the American, or Mammoth breed. There was considerable variation in quality and conformation among the individuals. Some of them were of the finer-boned kind, while others represented the large, heavier-boned type. At the time of purchase their ages ranged from three to nine years. The jennets cost $162.50 each, delivered to State College.

The average weights and some of the important measurements of each individual are shown in table 1. The average weights shown are the weights of the animal in normal condition, not heavy in foal. The heights were taken at the highest point of the withers, with normal hoof growth and no shoes. Thus, an animal 13-1 hands high (4 inches equal 1 hand) is 55 inches in height. The measurement of circumference of heart girth was taken around the body just be-

TABLE 1.—AVERAGE WEIGHTS AND SOME IMPORTANT MEASUREMENTS OF INDIVIDUAL JENNETS

Jennet number	Average weight	Foaled	Circumference of heart girth (inches)	Height (hands)	Circumference of fore cannon bone (inches)	Spread of ear (inches)
1	645	1933	57	13-1	6.5	30
2	780	1932	63	13-3	7.0	30
3	825	1929	68	14-2	8.0	34
4	655	1928	59	13-1	7.0	28
5	690	1928	63	13-3	8.0	32
7	950	1932	66	15-0	7.5	33
8	755	1927	63	13-1	6.5	30
10	810	1929	66	14-2	7.5	31
11	735	1930	64	13-1	7.0	28
12	855	1930	64	13-3	8.0	31

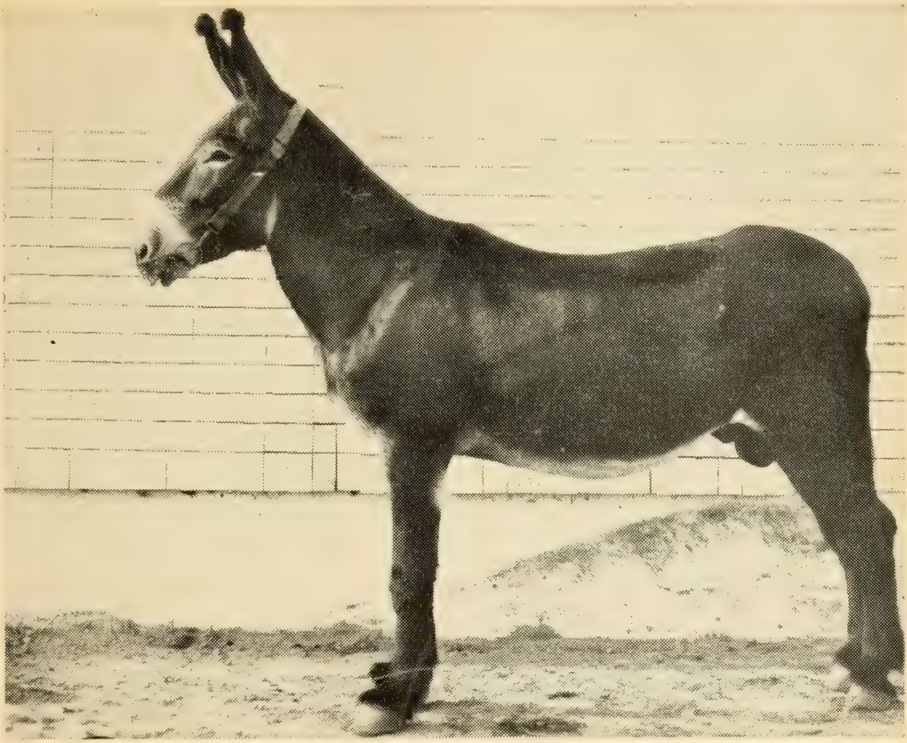

Figure 1. Alex Sims, Jr., sire of all young stock included in this report. Weight 1150 pounds, height 15-1 hands, bone 8½ inches, heart girth 72 inches.

hind the withers and the elbow joints. The cannon bone measurement was taken at the smallest point between the knee and fetlock joint. The spread of ear is a measurement of both ears spread to a horizontal plane, and the measurement was taken from tip to tip.

Jack: Alex Sims, Jr.

The sire of most of the jack and jennet foals included in this project was produced in Illinois, and was purchased by the Mississippi Experiment Station in the early spring of 1937. He is considered by good judges of jackstock to be an excellent individual. As a show jack, he was made grand champion at the Illinois State Fair in 1935, and placed at the top of his class at the Tennessee State Fair in 1936. He is black with white points, weighs 1150 pounds in ordinary breeding condition, is 15-1 hands high without shoes, and has an 8½ inch bone. He measures 72½ inches around the heart girth and has a 32-inch spread of ear. He was foaled in 1929.

Unlike most jacks, he will serve mares in preference to jennets. Occasionally he has refused to serve a jennet until a mare was placed in sight.

This jack was selected for use in this study because of his excellent conformation, strong feet and legs, quality, and pedigree. He has proved to be a good producer of mules as well as of jacks and jennets.

FEEDING AND MANAGEMENT OF MATURE JACKSTOCK

Feeding and Management of Jack

The grain feed used in maintaining the jack has consisted very largely of oats with a small amount of corn. The amount of grain fed daily during the breeding season was about 1 pound per 100 pounds liveweight. This amount of grain was found to be too much during the off-breeding season, as the jack became too fat. It was necessary, therefore, to reduce the amount of grain to about ½ pound per 100 pounds liveweight, or 5 to 6 pounds per day. Mixed hay, consisting mostly of lespedeza and Johnson grass, was fed in amounts varying from 5 to 10 or 12 pounds daily, depending upon the amount of grazing available. Every day during the year the jack has had the run of a grass lot of about one acre in size. He was usually closed in a box stall 20 feet by 20 feet at night and fresh hydrant water was always available while the jack was in the lot. Flake salt was given in a box separate from the feed and was the only mineral fed.

Summer Management of Jennets

From March 20 to about December 1 each year the jennets were maintained on improved permanent pasture, and no supplemental feed was given. No minerals were fed except salt. The pastures were on lime land more or less typical of that found in the Northeastern Prairie section of the State. Water was supplied from ponds or pools. The quality and quantity of grazing available throughout the grazing season were probably above the average for this section. The jennets were driven to the scale and weighed at the end of each 28-day period.

During May and June they were usually driven to the barn, along with mares, three times weekly for teasing or checking purposes. During the other months of the grazing season they were checked in pasture two or three times per week.

The individual weight records show that jennets can be carried on good permanent pasture with satisfactory results. They usually shed their winter coats and begin to show evidence of increased thriftiness in May and June. Jennets are good grazers, and their grazing habits seem to be no different from that of other species of workstock. They are less active than horses and mules and seem to be more clumsy. Occasionally one was found on her back in a terrace, unable to get on her feet. The habit of rolling in dust or on freshly-plowed soil is characteristic, and for this reason jennets, particularly those heavy in foal, should not be grazed on freshly terraced land if the terraces are steep.

Winter Management of Jennets

During the five winters, approximately from December 1 to March 20, all jennets except four were carried through the winter period while dry or after foals had been weaned, some being pregnant and others not in foal. These dry jennets were group-fed grain and hay in a stall 36 feet by 16 feet where they were kept at night. During the day they were turned into a dry lot where water was available in a concrete trough. The daily ration for the wintering period consisted of 6 pounds corn, 2 pounds cottonseed meal, and 12 pounds lespedeza or Johnson grass hay per 1000 pounds live-weight. The grain was divided into two equal feeds and fed morning and night, while all the hay was fed at the evening feed.

The ration used maintained the weight of most of the jennets during the winter. It was observed that jennets in groups winter better in a barn than do mares. There was no evidence of injuries caused by kicking and fighting as is often the case when mares are wintered in groups under a shed.

Jennets with late summer or fall colts

were wintered in individual box stalls 12 feet by 12 feet, and were fed more grain and less hay than was fed to dry jennets. The foals started eating grain when six weeks or two months old. They were allowed to eat grain from the trough with their dams during the wintering period.

FOAL PRODUCTION BY TEN JENNETS

Breeding Record of Jennets

The value of a jennet is based almost 100 percent upon her ability to reproduce. On account of her sluggish disposition and lack of correct conformation for pulling a load, she is seldom used for farm work. This partially explains why jackstock production has been of little importance as a farm enterprise in the cotton-producing states of the Southeast.

Jennets are usually bred as three-year olds, and foal the first time at four years of age. Well-developed individuals are sometimes bred at 2½ years of age and drop their first foals at 3½ years.

Jennets will show oestrus or heat any time during the year. The heat period and heat cycle of jennets vary considerably with individuals and with the season of the year. Some individuals remain almost constantly in heat during the latter part of the winter period, while during the spring after they have been on pasture a month or more, the length of the heat period is considerably shorter. It has been observed that most jennets will show signs of heat (foal heat) 2 to 8 days after foaling[1], and if not bred or if conception does not take place at that time will return in heat 22 to 24 days following foal heat or 24 to 31 days after foaling. Open or unbred jennets will show signs of heat at quite regular intervals, usually 21 to 24 days after the first day of the previous heat period. Jennets that are in heat usually can be easily identified. The opening and closing of the mouth in a chewing motion while around other horsestock is one of the most common signs of heat.

During the four years breeding program with the 10 mature jennets, it was found that on the average 70 percent of the jennets remained in heat 2 to 8 days, but there was considerable variation among the individuals. It was also found that the best time to breed jennets is toward the latter part of the heat period; or, better still, to breed them the first, third and fifth days if the length of the period is around the average. The average length of the gestation period of jennets was 367 days, ranging from 346 to 393 days.

It should be pointed out that not all jennets show foal heat; and some jennets, after showing definite signs of foal heat, will not return in heat for several

TABLE 2.—INDIVIDUAL BREEDING AND FOALING RECORD OF JENNETS

Jennet number	1937-1938-1939-1940		1938-1939-1940			
			Living offspring produced		Aborted	
	No. heat periods	No. times in foal	Male	Female	Male	Female
1	9	3	—	3	—	—
2	9	4	1	2	—	—
3	10	2	—	1	—	1*
4	28	1	1	—	—	—
5	11	1	—	1	—	—
7	11	2	1	1	—	—
8	3	2	1	1	—	—
10	11	3	—	1	—	—
11	10	4	1	—	3	—
12	10	1	—	—	—	1

*Sex unknown.

months. The usual practice of checking from 18 to 21 days after jennets have been bred does not guarantee that they are or that they are not in foal. Some of the Station jennets have returned in heat 60 days or more after being bred and considered as safe in foal.

Breeding records, as well as observations on the breeding habits and upon the care and management of jackstock and foals, were available for the years 1937-40, inclusive, and individual records for the 10 jennets are shown in table 2.

It will be noted that breeding records cover a period of four years, while foaling records cover a period of three years only; this for the reason that some of the jennets were pregnant when purchased. It was the plan to collect data on foals from a single sire, and the 1937 foals by different sires were not suitable for use in the experiment.

Hence, the foals of 1937 and one 1938 jack foal by a different sire, are included in the vital statistics only.

Foaling Record of Jennets

Altogether, during the 4-year period, the 10 jennets gave birth to 19 living foals. The 10 jennets were 23 times in foal, ranging from one time in foal by three individuals to four times in foal by two individuals (table 2). The 10 jennets were in heat 112 times, ranging from three heat periods by one individual to 28 heat periods by one individual.

During the 3-year period in which foaling records were kept (table 2), the 10 jennets produced five living jack foals and 10 living jennet foals; while three jack foals (including one set of twins), one jennet foal, and one foal of undetermined sex were aborted or stillborn.

The data given in table 2 do not take into account all of the times each jennet was bred; it was the practice to breed them two or three times during each heat period to increase the chances of conception.

Table 3 gives a general summary of the 4-year breeding record and the 3-year foaling record of the 10 jennets.

Based on an average for both these periods, the 10 jennets produced an average of ½ foal per year, or an individual average of one foal every two years. To produce a living foal of either sex, it was necessary to breed jennets on an average of almost five heat periods. To produce a living jack foal, since the jack

TABLE 3.—BREEDING RECORD OF JENNETS (4 YEARS) AND FOALING RECORD (3 YEARS)

Breeding Record: 1937, 1938, 1939, 1940	
Number of jennets	10
Total number of times in heat	112
Average number of times in heat per jennet	11.2
Average number of times in heat per jennet per year	2.8
Total number of living foals produced (1937-1938-1939-1940)	19
Total number of abortions (twin-abortion counted as 1)	4
Total number of pregnancies	23
Average number of pregnancies per jennet per year	.59
Average number of heat periods per pregnancy	4.8
Average number living foals produced per jennet per year	.48
Foaling Record: 1938, 1939, 1940	
Total number of jacks born:	
living	5
dead	3
Total number of jennets born:	
living	10
dead	1
Total number born dead, sex unknown	1
Average number of living jack foals per jennet per year	.166
Average number of living jennet foals per jennet per year	.33

foals represented one-third of the total, it was necessary to breed jennets on an average of 22.4 heat periods.

It will be noted that in this experiment, two jennet foals were produced to one jack foal. These figures would tend to substantiate the general belief that the ratio of jennet foals to jack foals is approximately two to one. However, no statistics which included a sufficient number of individuals have been reported to justify this belief, and the idea is not founded upon genetic principles. It has been determined with other classes of livestock that, large numbers considered, the sex ratio or the number of males to females was approximately the same.

The foaling record of the 10 jennets and the one jack used in this project for a 4-year period shows that it was necessary to maintain six jennets in order to produce one living jack foal each year.

FIVE JACKS AND TEN JENNETS PRODUCED

Weights, Measurements of Foals

Four of the five jacks dropped in the 3-year period, 1938-1940, were sired by the Station jack, Alex Sims, Jr., shown in figure 1, and records of weights and important measurements have been kept on them and are presented in table 4. One of the jack foals of this period had a different sire, was disposed of at two years

TABLE 4.—WEIGHTS AND MEASUREMENTS OF JACKS PRODUCED AT STATE COLLEGE 1938, 1939, AND 1940, AND OF THEIR DAMS

Weight (Pounds)

Jack No.	Dam	Birth	Weaning	1 yr.	1½ yrs.	2 yrs.	2½ yrs.	3 yrs.
08	8	72	420	535	695	690	935	985
28	11	100	370	460	580	685	770	815
38	4	71	335	420	520	570	590	615
09	2	78	405	515	640	810		
48*	7							

*Disposed of at 2 years old.

Height (Hands)

Jack No.	Foaled	Birth	Weaning	1 yr.	1½ yrs.	2 yrs.	3 yrs.
08	1938	8-2½	12	13-½	14-0	14-2	15-0
28	1938	8-2½	11-¾	12-½	12-2½	13-1	13-2
38	1938	8-2	11-½	12	12-2½	12-3¼	13-0
09	1939	8-3	12-¾	13-2	13-3½	14-1¾	

Heart Girth (Cm.)

Jack No.	Birth	Weaning	1 yr.	1½ yrs.	2 yrs.	3 yrs.
08	68	116½	135	153	161	169
28	76	116	134	137	155	163
38	67	111	127	134	140	147
09	72	122	135	147	158	

Circumference of Fore Cannon (Cm.)

Jack No.	Birth	Weaning	1 yr.	1½ yrs.	2 yrs.	3 yrs.
08	11.5	16.5	19.0	20.0	21.5	22.0
28	10.5	15.0	17.0	17.5	18.5	19.0
38	11.5	15.0	17.0	17.5	18.0	18.0
09	11.5	16.0	18.5	19.5	20.0	

Dams of 4 Jacks Above

Jennet No.	Weight (pounds)	Height (hands)	Heart girth (cm.)	Circumference of fore cannon (cm.)
8	645	13-3	160	18
11	755	13-1	160	17
4	735	13-1	163	18
2	655	13-1½	149	17½

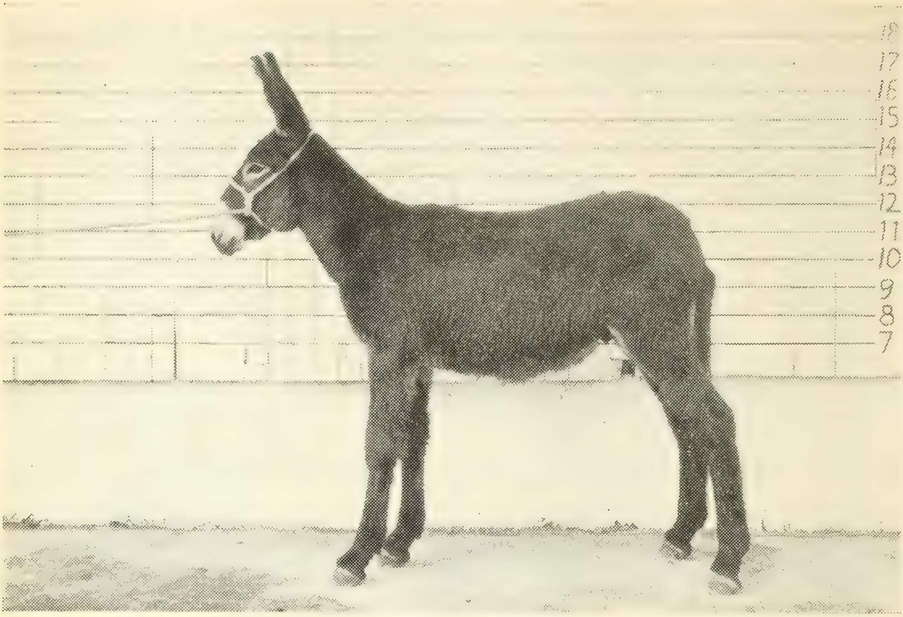
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Figure. 3A. Jack foal Number 08 at approximately 3 months old; weight 72 pounds at birth and 420 pounds when weaned.

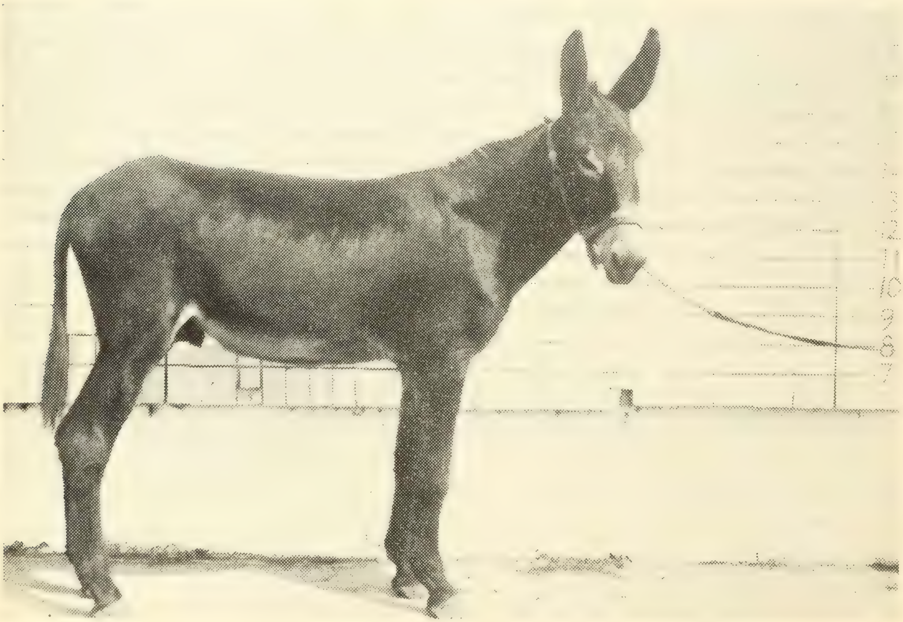

Figure 3B. Jack Number 08 at 1 year old; weight 535 pounds and showing promise.

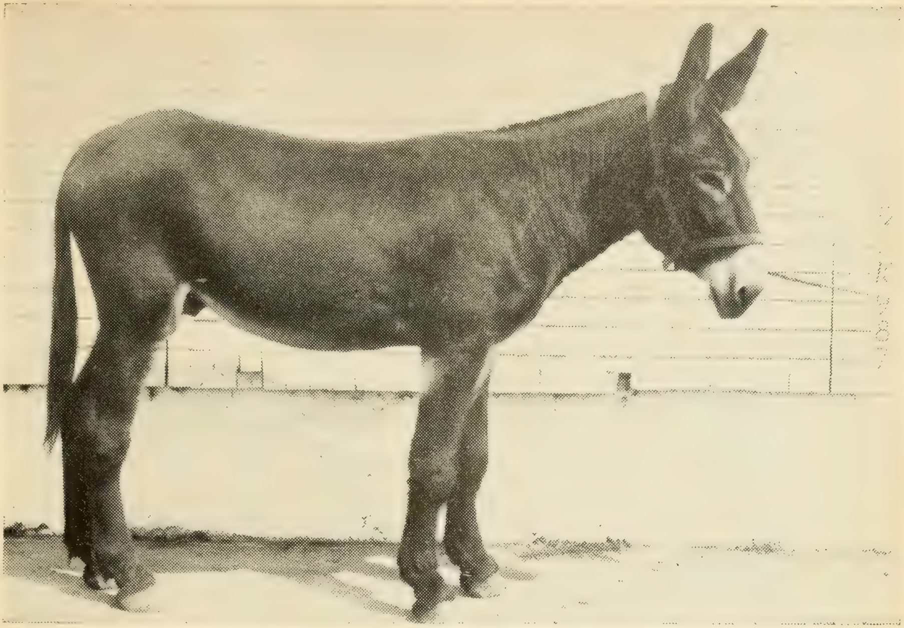

Figure 3C. Jack Number 08 at 2 years old; weight 690 pounds, height 14-2 hands.

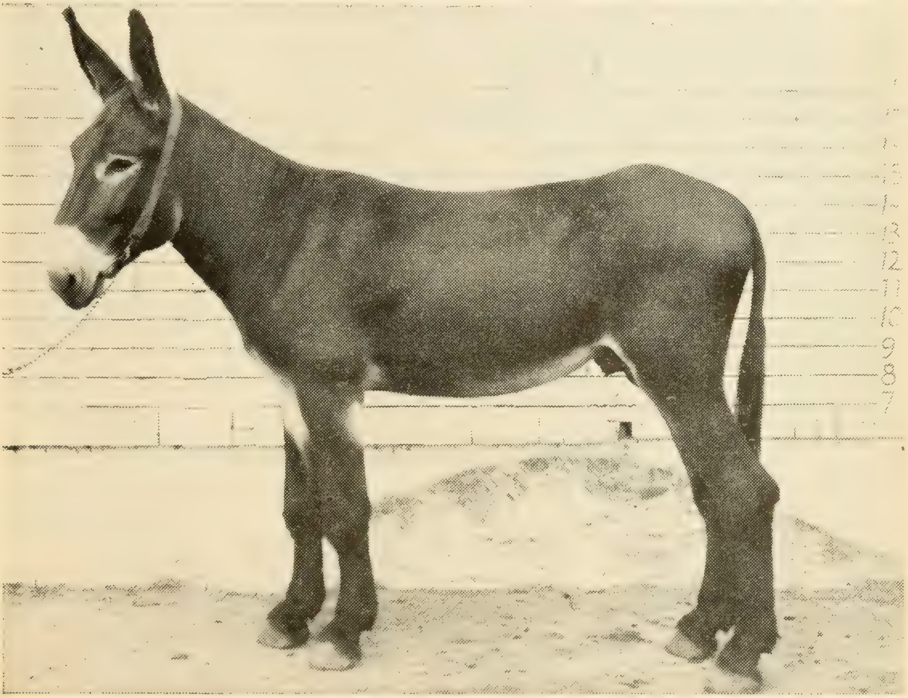

Figure 3D. Jack Number 08 at 3 years old; weight 985 pounds, height 15-0 hands, fore cannon 22.0 cm. First prize jack at the Mississippi State Fair, 1941.

of age, and is not further included in the records.

Jack number 28, dropped in 1938 and out of jennet number 11, is shown in figure 5; jack number 38, dropped in 1938 and out of jennet number 4, is shown in figure 4; and jack number 09, dropped in 1939 and out of jennet number 2, is shown in figure 6.

Jack number 08, dropped in 1938 and out of jennet 8, is shown in figure 3A at three months old; in figure 3B at one year old; in figure 3C at two years old: and in figure 3D at three years old.

In table 4, (see page 9) are given the weight, and the height, heart girth, and bone measurements of each of the three 1938-born jacks from birth to three years of age and of the one 1939-born jack from birth to two years of age. It is noted that the increase in weight as well as all measurements taken was greater for the period from birth to weaning than for any other period. There was no correlation of birth weights and measurements taken at birth and weights or measurements taken at two and three years of age. In other words, with these four jack colts it would have been impossible to select the most desirable jack on the basis of the birth weight and birth measurements. At weaning age, the weight, height, and circumference of heart girth data indicate slightly what might be expected in the mature individual. In some cases, the differences in weight and the above measurements of individuals became more pronounced with age.

Table 4 also shows the average weights and corresponding measurements of the dams of the four jack colts. It is noted here that the height and bone measurement of the four jennets are fairly uniform, yet there is a wide variation in size, type, and conformation of the offspring produced. For example, jennet number 8 (dam of number 08 jack) and jennet number 4 (dam of number 38 jack) have the same bone measurements and jennet number 4 has a 3 cm. advantage in size of heart girth, while number 08 jack has a larger bone by 4 cm. and is 22 cm. larger in the heart girth at three years of age than has jack number 38. It can be interpreted from the very limited amount of data shown that within a certain range, the size of the dam is no indication as to the size of the jack offspring that will be produced.

It will be remembered that the four jack colts referred to above were all sired by the same sire and have been developed on the same feed and under as near the same environmental conditions as was practicable.

Growing Stock Jacks

The five living jack foals reported in table 2 did not include two other jack colts that have been raised from the 10 jennets—one foaled in October 1936, and the other in April 1937. Since these two foals did not represent the breeding desired, they were disposed of at three years of age and are not further included in this report. One of the four that was foaled in 1938 was also disposed of for the same reason. The detailed records reported herewith, therefore, are those taken from the four young jacks all sired by the same sire and foaled during the 3-year period, 1938 to 1940, inclusive. These four jacks will be maintained on the Mississippi Experiment Station Farm for use in mule-efficiency studies. Three of these jacks were foaled in the spring of 1938 and the fourth was foaled one year later.

Growing Jennets

The jennets produced in this study have been developed largely on permanent pasture, with a period of about 100 days during the winter in which they were fed harvested feeds. The grain feed for weanlings, yearlings, and two-year-olds during the wintering periods was corn, eight pounds, and cottonseed meal, two pounds, per 1000 pounds liveweight, re-

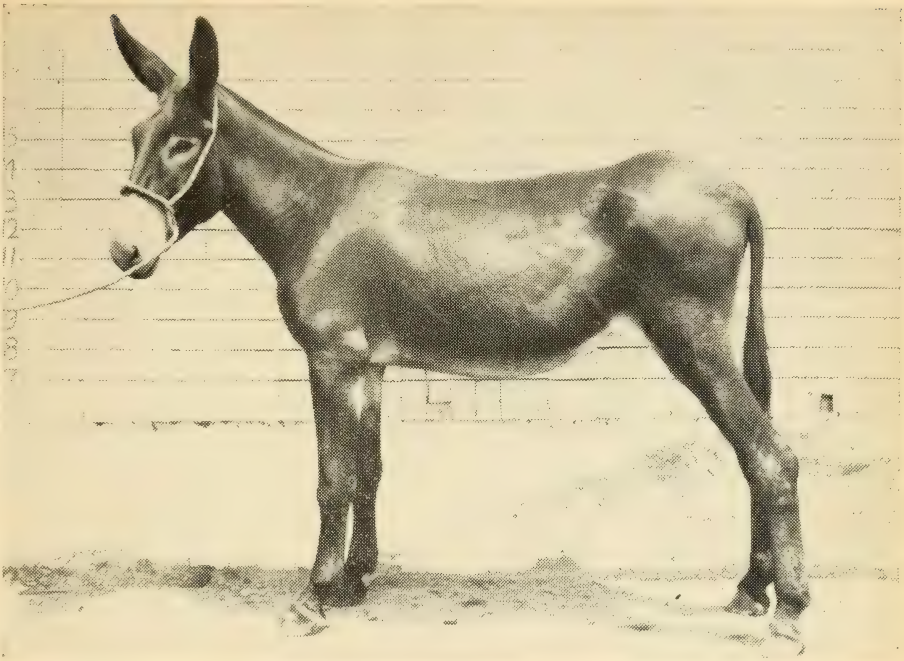

Figure 7. Jennet Number 18 at 3 years old—smooth, 14-1 hands high, with plenty of substance and quality. Produced at Mississippi Experiment Station.

spectively. The roughage used has been Johnson grass and lespedeza hay fed at the rate of 12 pounds per 1000 pounds liveweight. The same weight, photographic, and measurement records were taken on the growing jennets as was the case with the young jacks.

One of the better jennets produced, number 18, is shown in figure 7.

Under this method of management, the jennet colts developed normally, and as four-year-olds they apparently possess a sufficient amount of size, bone, and the other qualifications necessary to produce good, vigorous colts.

Individual Records

An effort has been made to obtain information on these colts that could be used as a basis for setting up dependable recommendations on the production of jackstock in Mississippi. It is realized that the number of animals is small, and that with larger numbers more dependable observations might have been made. Individual weight records have been taken at regular intervals since birth. Photographs of each colt have been made at intervals from the same background with the camera placed approximately the same distance away each time. The background was graduated in hands, so that each picture made is a true indication of height and other dimensions. Individual measurements of height, bone (rear and front leg), heart girth, spread of ear, length of body, depth of hock, circumference of knee, and depth of body have been made semi-annually.

Measurements

Visual observations are sometimes misleading, but when tape measures and measuring rods are used to determine height, circumference of heart girth, etc., the results are much more dependable.

A metal tape graduated into centimeters on one side and inches on the other was used. A metal graduated rod with a movable perpendicular piece was used to determine the height. A similar graduated rod with a stationary perpendicular end piece and sliding parallel piece was used to determine width of shoulder, depth of chest, depth of hock, etc.

The object in taking these various measurements was to determine their relationship to each other and the relationship of any or all of them to the efficiency of a jack or the ability of a jack to sire good mules. When a sufficient number of such records is available, it might be possible to discard certain individuals at an early age and eliminate the cost of producing them to maturity and maintaining them until their breeding worth can be determined.

Weights

After weaning age, individual weights were taken every 28 days in order that a growth curve of each jack might be studied. It has been determined with other classes of livestock that weight for age is an important factor in performance records. Just how much of a factor weight for age is with jackstock has not been determined.

FEEDING AND MANAGEMENT OF GROWING JACKSTOCK

Two of the three 1938 foals were born April 22 and the other one May 21. The mothers had been on pasture with no supplemental feed for 30 to 60 days. About August 1 the three jennets and jack foals were moved to a pasture nearer the barn. The foals were separated from the jennets about two hours each day and given a feed of oats. About two weeks time was required for the foals to become accustomed to eating grain. Oats were fed as a supplement to their mothers' milk for the remainder of the suckling period. The amount consumed varied from about ½ pound at the beginning to 3 or 4 pounds per colt per day toward the end of the suckling period.

On November 26 the foals were weaned and placed in their winter quarters which consisted of an acre grass lot and a shed 10 feet by 16 feet which opened to the south. The feed bunk and hay rack were built under this shed. The three foals were wintered together, along with a filly about the same age.

Winter Ration

For the wintering period they were fed

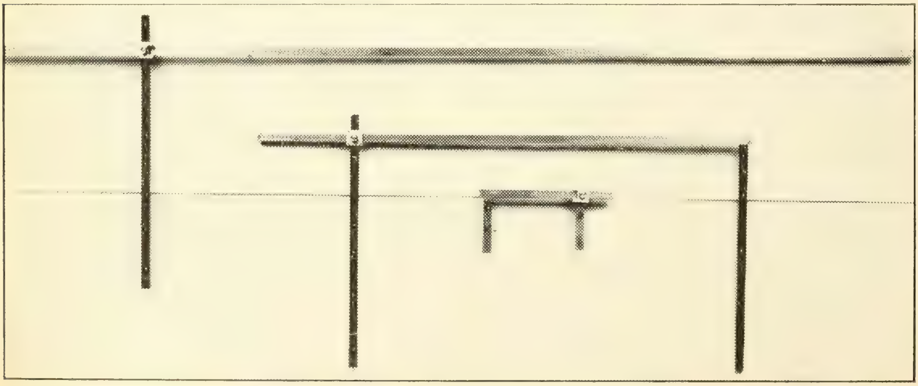

Figure 2. Instruments used in taking measurements of jackstock.

a grain ration made up of the following mixture:

Oats	5 parts
Corn	3 parts
Cottonseed meal	1 part
Wheat bran	1 part

The colts readily consumed the above mixture in the amount of 1 pound per 100 pounds liveweight when fed twice daily. The roughage was principally lespedeza hay, twelve pounds of which were fed per 1000 pounds liveweight. Fresh hydrant water was available at all times. On March 20, 1939, the three yearling jacks were turned on permanent pasture where there were no other workstock except the filly with which they had been during the previous wintering period. From March 20 to October 28 no supplemental feed was given. However, the pasture on which they grazed contained an abundance of grazing throughout the grazing period. Hop clover, black medic, wild barley, cheat, and white dutch clover furnished the early grazing, and from about May 1 to the end of the grazing period dallis and bermuda grass were the dominant plants.

On October 28, 1939. the three young jacks were separated and placed in individual stalls and have been handled separately since that date. The 1939 jack foal was handled very similarly to that of the three 1938 foals.

Care was taken at all times after weaning not to allow the young jacks to be near jennets or mules. It is often the case that when jacks are raised with jennets or even pastured in adjacent pastures they will not serve mares readily unless a jennet is in sight. The same experience has been noted with a few jacks that were raised with mules. Even with the most careful attention given to this problem some jacks will become "jenet spoiled"; this will be more fully discussed under the subhead, "training jacks to serve mares."

For the most part, the ration fed since the young jacks were stabled has been the same as that fed during the first winter. There have been brief periods when it was considered advisable to reduce the amount of grain or even change the grain mixture entirely to oats.

A two-acre grass lot has been available for the four jacks. Since only one could occupy the pasture at a time, it has been necessary to alternate them night and day so that each jack would be out as much of the time as possible. The paddock has been planted in oats for fall and winter grazing and sudan grass for summer grazing. An effort was made to have green feed available throughout the year. Planting is usually delayed on one-half of the land until that on the other one-half is ready for grazing. The grain has been divided into two equal feeds and given morning and night. The hay has been fed at night.

Care of Feet and Legs

When the jacks were from 8 to 12 months old their feet were trimmed and have been trimmed regularly about every 6 to 8 weeks. Regular attention given to the feet probably means straighter legs and feet at maturity. Shoes have not been used on any of the jacks. Regular trimming of the feet seems to be necessary because jacks do a small amount of walking on a gritty surface, hence the wall of the hoof grows faster than it wears off. A pair of hoof nippers, a knife, and hoof rasp are the tools that are available for this purpose. Oiling the hoof is claimed by some good veterinarians to be a bad practice. Oil, it is claimed, excludes moisture which seems to be necessary to keep the hoofs soft, pliable, and tough.

If a jack is allowed the run of a grass paddock day and night, his feet will usually be in much better condition than if kept in a stall. The dew on the grass during the night and early morning and the moist soil is a healthy environment for the feet of jacks.

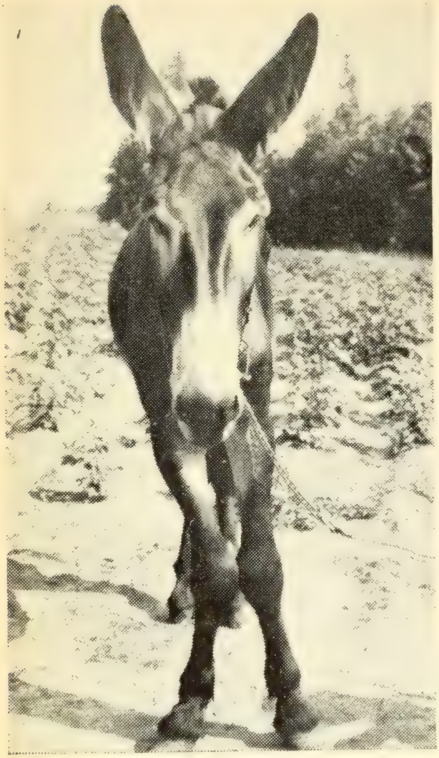

Figure 8A. Front view of the Halloween jack that became crooked in front legs at 1 year of age—probably caused by mineral unbalance.

Constant stabling increases the chances for foot infection. On two occasions the feet of two of the jacks became infected with thrush, a disease that attacks the sole of the hoof and, if left untreated, will cause the entire sole to slough off. The disease is characterized by a foul smell and the discolored dead tissue on the infected parts. The treatment usually recommended is that of trimming the infected tissue away and treating the sole with nitric acid. If the stalls are cleaned every week and kept well-bedded so that the feet do not come in contact with moist manure, the trouble no doubt would be reduced to a minimum.

Occasionally a vigorous growing jack will become crooked in the front legs at about one year of age. This condition is caused by nutritional disturbance in bone formation. The jack shown in figure 8 was foaled on Halloween night 1937 and is out of jennet number 3. This jack was apparently perfectly sound and normal until he was about one year old. At about 12 to 14 months of age his front legs began to become noticeably crooked, more pronounced with the right than the left. Up to that age the colt had been fed about all of the grain that he would consume and a good quality of mixed hay. He had been given the run of a good grazing lot where plenty of clovers and grass was available during the grazing season. Oystershell flour and salt were available after the colt was weaned at about 7 months of age.

After the crooked condition became apparent, codliver oil was mixed with the feed and bone meal was substituted for oystershell flour, but neither seemed to be effective in correcting the condition. The writer has seen one case that was similar, except the legs were bowed outward in the form of a semicircle whereas Halloween's legs are bowed inward.

It is believed by some observers that big-boned, vigorous growing jacks should not be developed too rapidly for the first two years, a factor that does not seem to be so important with the finer-boned type that makes slower growth. With the Halloween jack, since he had been raised on his mother's milk plus a supplement of oats, and good hay and minerals to weaning and had been fed oats and hay with good grazing produced on limestone soil since weaning, no other logical reason for the crooked legs can be offered than that he was pushed too fast. This condition is usually referred to as rickets.

Front and side views of the deformity of the Halloween jack are shown in figures 8A and 8B.

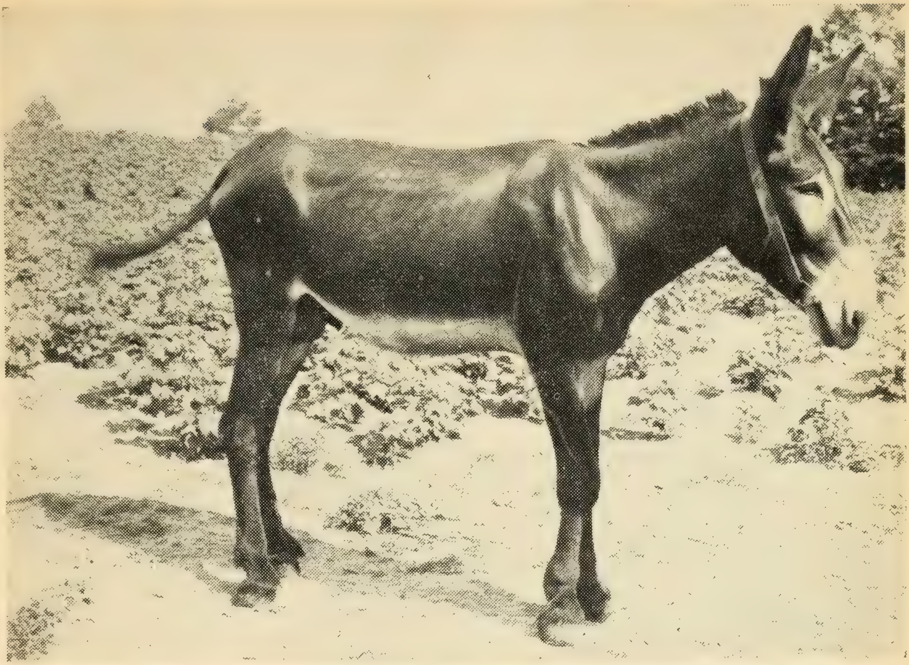

Figure 8B. Side view of the Halloween jack, showing crooked front legs.

Training Jacks to Handle

The belief among some people that a jack is a vicious animal and that to handle him requires the use of a black snake whip, is not based upon actual facts but probably a remembrance of some individual that had been spoiled as a result of poor management. As a matter of fact, a jack is no different from other species of workstock in his response to training. After being properly trained he is one of the easiest to handle. Like other young stock the earlier the training begins the less difficult the undertaking. The colts produced in this study were halter-broken and trained to lead during the suckling period. They have been handled almost daily since, with the exception of the periods when they were on permanent pasture.

After a colt is about 18 months old he begins to become unruly when handled with a halter. It is necessary, therefore, to start "bitting him" or training him to be handled with a bridle. The important point in this connection is to provide a bridle that is easily put on and taken off. Most jacks are touchy about the ears and any jack can be completely spoiled by careless management. The ears should never be touched by the handler or trainer except when they are to be trimmed or the mane roached.

Jacks are usually handled with an ordinary snaffle bit and a bridle made from one 1½" strap of leather bradded to the bit on one side and to a snap on the other side. No briar band or throat latch is needed. A strap of leather 1" wide and 8′ long with a chain chin piece makes a satisfactory lead. The chain run through one ring of the bit under the chin and snapped to the ring on the opposite side is sufficient-

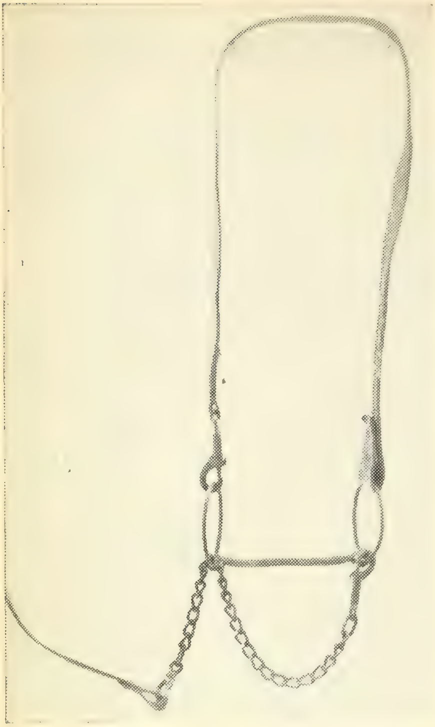

Figure 9. A home-made bridle satisfactory for handling jacks after 1 year of age.

ly rough for the most unruly jacks and yet not too rough for those with milder temperament. A satisfactory home-made jack bridle is shown in figure 9.

Jacks should be trained to be approached in the stall from the left side. The snap end of the bridle is first thrown across the neck from the opposite side with the handler standing on the left, the bit placed in the mouth and snapped to the bridle. The bridle on top of the neck can now be gently moved to just back of the ears and the jack is ready to be handled.

Training Jacks to Serve Mares

The "breaking-in" period represents one of the most critical periods in the life of a jack. The natural inclination of most jacks is to serve jennets rather than mares, and for this reason every precaution should be taken after jacks are weaned to handle them in such a way that they will not become "jennet-spoiled." In this study a filly colt approximately the same age as that of the jacks was allowed to remain with the colts during the first winter and the following grazing season. As has been mentioned, an effort was made not to allow the young jacks to come near jennets during this period or later.

At about 20 to 24 months of age the colts were bred to a mare. The mare used was gentle and fully in heat each time the jacks were tried. Hobbles were placed on the hind legs of the mare to prevent any danger from kicking. No trouble was experienced in getting all of the jacks, as two-year-olds, to breed a mare. They were allowed to serve five or six times at weekly intervals.

The plan at the beginning of the 1941 breeding season was to breed each of the three 3-year-old jacks to a definite number of mares for experimental purposes. Two of them served the allotted number of mares readily, but number 38, the smaller of the three, definitely refused. He was worked with two or three times weekly for about two months during the breeding season without any results. On August 1 this jack was tried on a jennet fully in heat and served her in about ten minutes' time. The following day he was tried on the same mare that he had served as a two-year-old, but again he refused to serve. The training was continued, and no trouble was experienced the following day in getting the jack to serve a mare after a jennet had been placed near him.

This jack is a typical "jennet-spoiled" individual. He was developed under the same environmental conditions as two other jacks that served mares normally. The details are mentioned in order to point out the fact that each individual jack is inherently different from all oth-

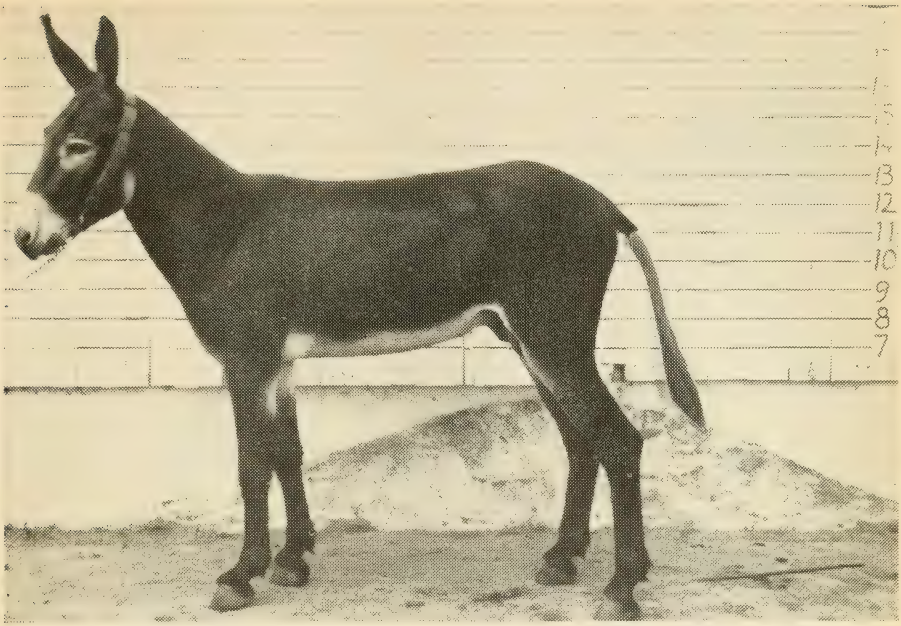

Figure 4. Jack Number 38 at 3 years old; weight 615 pounds, height 13-0 hands.

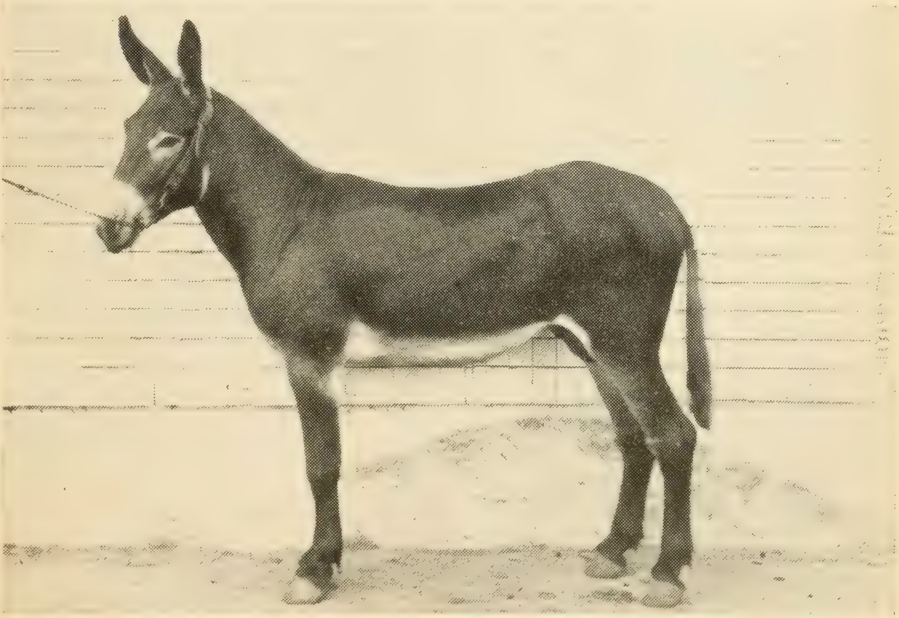

Figure 5. Jack Number 28 at 3 years old; weight 815 pounds, height 13-2 hands.

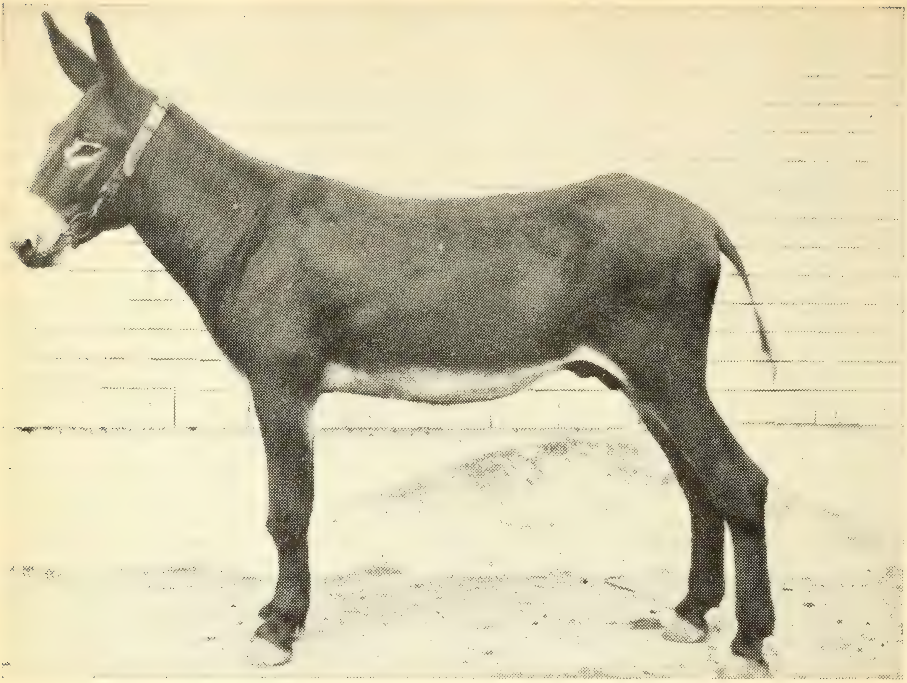

Figure 6. Jack Number 09 at 2 years old; weight 810 pounds, height 14-1¾ hands. This young jack was the heaviest of the four at two years old, and was taller and had a bigger bone at 2 years old than did Number 28 and Number 38 at 3 years old.

ers, a fact which should be taken into consideration in their management.

Breeding Method

Since 1937 the horse breeding work carried on at the Mississippi Experiment Station has been done by the artificial method; that is the semen was collected from the jack or stallion in an artificial vagina, placed in a capsule, and the capsule deposited in the genital tract of the female. The important point in breeding any class of livestock is to get a good quality of semen in the genital tract of a vigorous, healthy female at the proper time. The method seems to be less important. There are certain problems. however, in connection with the artificial method of breeding workstock that have not been solved and for this reason the practice has not been generally recommended even though good results have been obtained in some instances.

Jack Sores

A jack sore is a term applied to localized chronic irritations which seem to be peculiar to jacks and jennets. This term is familiar to everyone who has had experience with jacks and jennets. The irritation may develop on any part of the body, but most often on the legs around the joints. The size of the affected part may range from a scratch, barely noticeable, to that which involves the entire joint.

One jack that was on the Mississippi Station farm from 1928 to 1934 was a victim of a jack sore of the worst order. A horizontal crack in the skin in front of the hock was the first noticeable sign. This break in the skin gradually widened and deepened until after a few months it had developed into a gangrenous sore which involved the entire front portion of the hock joint. Good veterinary assistance was available, but no treatment applied was effective in ridding the animal of the unsightly, troublesome sore.

None of the jacks produced in the present project has been affected with chronic sores. As a two-year-old jack number 28 had a slight irritation on the front of both hocks, but only for a short period of time. On several occasions sores have appeared on the legs of jennets, but in all cases they eventually healed.

The cause of jack sores is not definitely known. A number of contributing factors based on observations made while producing and maintaining jacks and jennets on the Mississippi Experiment Station might be mentioned.

1. **Temperament** — It has been noticed that some jacks are very sluggish and tend to take an insufficient amount of exercise. The sluggish disposition very likely causes poor circulation of the blood which in turn slows down healing when a scratch or a break in the skin occurs. The generally sluggish condition seems to be most common with leggy, shallow-bodied jacks that otherwise possess poor conformation.

2. **Feed** — It is believed by some jack owners that too much corn will cause jack sores. This belief is probably correct for jacks of certain types. It cannot be taken as an invariable rule, however, that all jacks that are fed corn as the only concentrate feed will develop jack sores. Again, the sluggish type of jack seems to be more often affected from feed. One jack used by the Mississippi Station was fed corn as the only concentrate for more than a year, and no trouble was experienced from jack sores.

3. **Temperature** — It is a fairly definitely established fact that jacks are more susceptible to skin troubles during hot weather than during the winter months. It is rather difficult to prevent jack sores from appearing on growthy, heavy-boned young jacks if they are full-fed or fed a heavy grain ration during the hot months. The grain feed has been reduced to about one-half of a full ration with the larger type jacks produced in this study.

For the prevention of jack sores the Mississippi Experiment Station recommends the following management practices:

1. Feed a well balanced grain ration and a good number 1 quality of legume and grass (mixed) hay.

2. If a break in the skin appears, reduce the grain feed to approximately one-half of a normal ration.

3. Provide a grazing lot not less than one acre in size that will afford green feed as many months during the year as possible. Arrange the stall so that the jack can go in and out at will.

Parasites

Jackstock as well as other classes of workstock are affected with parasites of both the internal and external species.

The horse bot (Gastrophilus intestinalis) is probably one of the most common internal parasites of horses and jackstock. A satisfactory treatment for this pest has been known for several years and is fully explained in Farmers' Bulletin No. 1503[9], U. S. Department of Agriculture, Washington, D. C. The animals used in this study have been given the standard treatment of carbon disulphide in December or January each year. The horse bot is the only internal parasite for which the animals have been regularly treated.

Mange and Lice.—Jacks and jennets appear to be more susceptible to mange and lice than other species of workstock. This is probably due to the fact that they grow longer coats of hair during the winter season than do horses or mules. The hair on young stock often

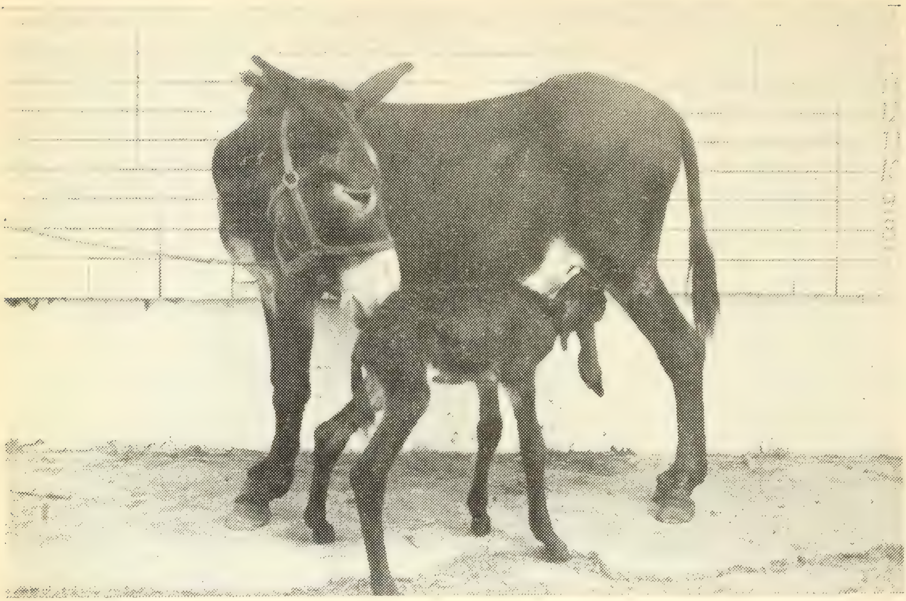

Figure 10. Jennet Number 8 with her one-day-old jennet foal.

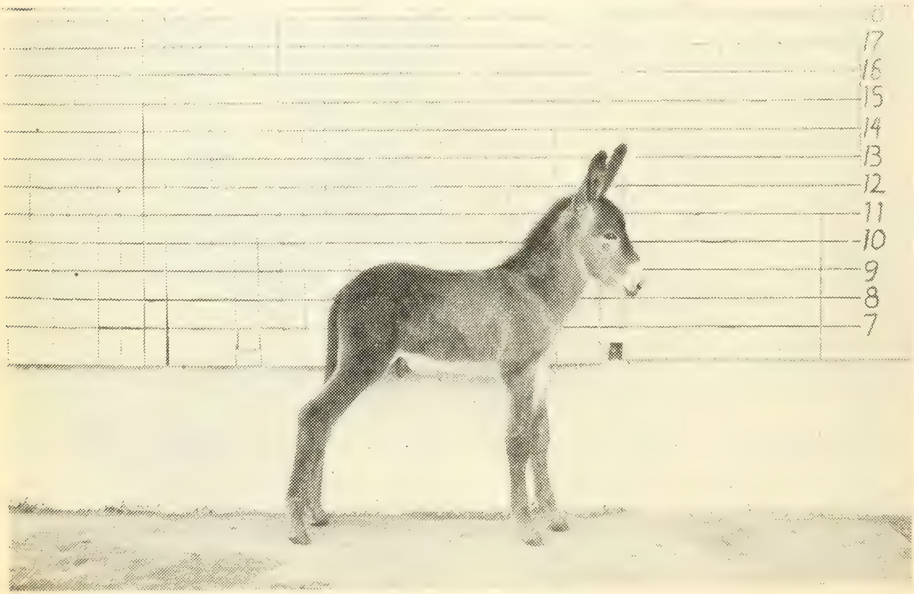

Figure 11. Jack foal Number 48, 5 days old, red sorrel. Went to Alcorn A. and M. College at 2 years old when weight was 630 pounds.

grows to from three to five inches in length during the late winter and early spring. The heavy covering of hair affords an excellent hiding place for biting and sucking lice and also for the parasites that cause mange. Animals suffering from a heavy infestation of lice become unthrifty and fail to gain in weight regardless of the kinds or amounts of feed consumed. The lice can be found most readily at the base of the mane and along the back.

A satisfactory treatment for mange and lice recommended by Dr. C. B. Cain, formerly connected with the Mississippi Experiment Station, is a solution made up of one quart of arsenical cattle dip to 35 gallons of water. The affected animals should be washed with the solution (warmed to body temperature) about every three weeks. It is important that the skin of the animal be thoroughly wet in order to bring the solution in direct contact with the parasites. It might even be necessary with some cases to clip the animal so that the solution will reach the skin during the washing process.

SUMMARY

Four years work by the Animal Husbandry Department of the Mississippi Station indicate that good strong jackstock can be produced in Mississippi, and that no small part of the successful production of good jacks and jennets is dependent upon good pasture.

The harvested feed cost of maintaining mature jennets for one year ranged from $15.00 to $25.00, depending upon the foaling date. The maintenance cost of jennets that foaled in the fall was considerably greater than for those that foaled in the spring.

The jennets at breeding age represent a harvested feed cost of approximately $35.00, with grain charged at $1.50 per hundred and hay at $10.00 per ton.

The jacks produced in this study each consumed approximately 2½ tons of grain and 2¾ tons of hay to breeding age or three-year-olds. The harvested feed cost was slightly more than $100.00 per jack.

If jacks could be sold at breeding age at an average price of $581.00 (price paid by Farm Security Administration 1936 to 1940, inclusive), even with the unfavorable sex ratio obtained in this study, a small profit could be expected with a limited number of good jennets and a good sire available. With a more favorable sex ratio the economic phase of this study would have been more favorable.

The breeding records reported indicate that jennets are harder to get settled in foal than mares. Under the conditions of this experiment it was necessary to breed jennets on an average of 4.8 heat periods to produce one foal.

ACKNOWLEDGMENT

Cooperating with the Mississippi Agricultural Experiment Station in this project are: Bureau of Animal Industry, Washington, D. C.; Tennessee Experiment Station, Knoxville, Tennessee; Missouri Experiment Station, Columbia, Missouri.

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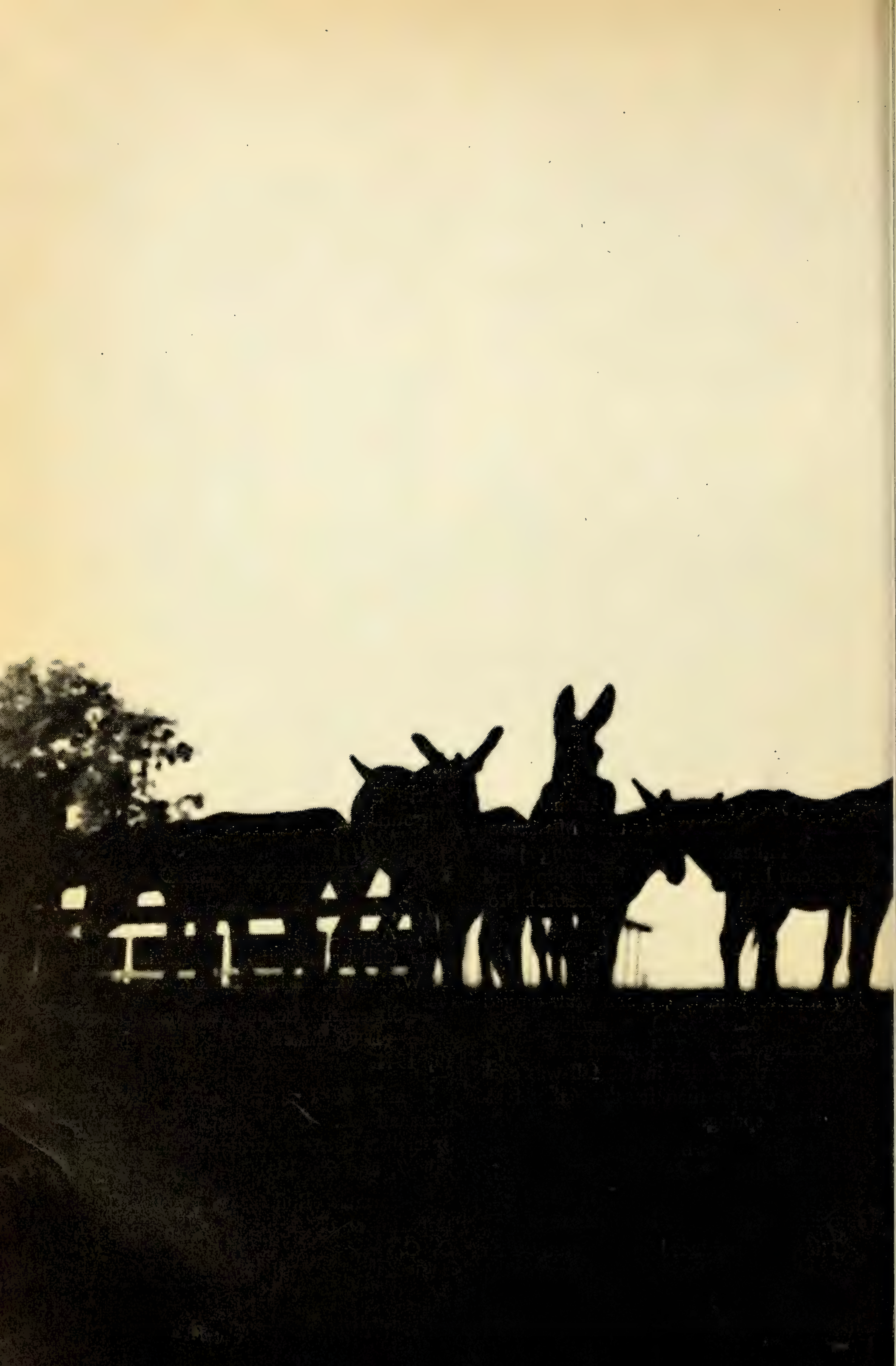
5 and 7 Personal Correspondence, Marshall E. Cole, State Cooperative Specialist, Farm Security Administration, July 7, and 26, 1941.

9—Farmers' Bulletin No. 1503, U. S. Department of Agriculture, Washington, D. C.



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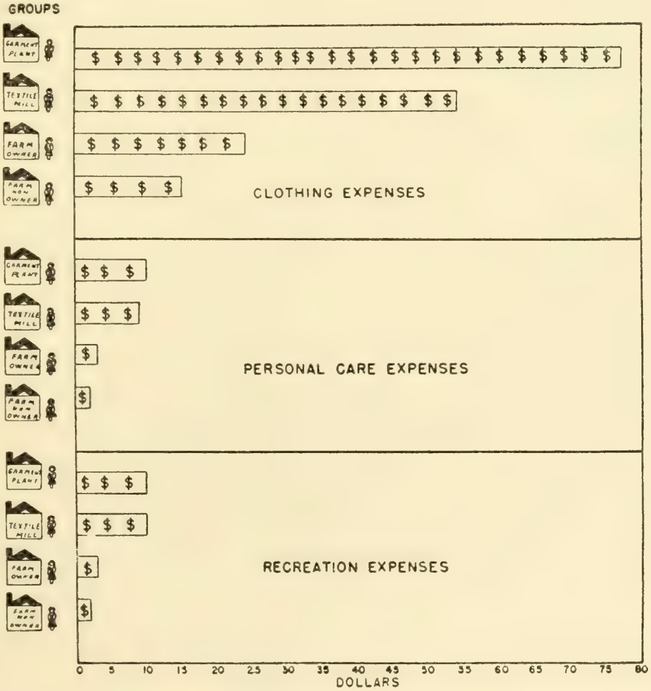
Bulletin No. 364 **November 1941**

SOME CONTRASTS IN THE LEVELS OF LIVING OF WOMEN ENGAGED IN FARM, TEXTILE MILL, AND GARMENT PLANT WORK



AVERAGE CASH EXPENDITURES OF SINGLE, GARMENT PLANT, TEXTILE MILL, AND FARM GIRLS FOR CLOTHING, PERSONAL CARE AND RECREATION DURING 1938-39.

Mississippi Agricultural Experiment Station
Mississippi State College
CLARENCE DORMAN, Director
STATE COLLEGE, MISSISSIPPI

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APPENDIX 51

Some Contrasts in the Levels of Living of Women Engaged in Farm, Textile Mill, and Garment Plant Work

By DOROTHY DICKINS
Head of Home Economics Department

In previous studies of farm people of Mississippi made by this Department, low standards of living and low incomes have been shown to be quite common.[1] Seventy-five percent of the farmers' sons and daughters who were out of school were found to be farming or were dependent at least in part upon the farm for livelihood. Two-thirds were entirely dependent upon the farm. The vast majority of the farming sons and sons-in-law were farm laborers, croppers, and tenants, having low cash incomes. Relatively few were farm owners, and many of these had mortgages on their farms. A need for more work opportunities was indicated, or a better balance between agriculture and industry.

The question has been raised, however, whether industrial employment would provide a better living than the farm, even in poor agricultural areas; whether transfer from one occupation to another would be merely a swap from one set of evils to another. In other words, what are the effects of an industrial program upon the family and its members?

The investigation herein reported is limited to the situation of women employed in cotton textile mills and cotton garment plants, as compared with women who assist with the production of one or more farm products offered for sale; all located in poor agricultural areas where more means of earning are needed. Is the situation of the women in these industries better than the situation of the women in farm work? What are the determining factors? What advantages and disadvantages has one type of living over the other?

METHODS AND SCOPE OF THE STUDY

Survey of industries employing women. A list of the 40 Mississippi counties least suitable for permanent arable agriculture was obtained from the Land Utilization Division of the Farm Security Administration.[2] The Secretary of the Chamber of Commerce of the county seat, or in cases where there was not a secretary, the mayor in the county seat in each of the 40 counties was asked for the names of the factories employing white women in their counties, the year each started, the approximate number of white women employed, and the type of work done. Replies were obtained from all 40 counties. There were no factories employing white women in 25 of the counties; nine counties had one factory employing white women; four counties had two factories each; one county had four factories; and one county had five factories. In other words, in this group of 40 counties, there were 26 factories employing white women. This included several that offered seasonal employment only. In the group were eight cotton garment plants, five cotton textile mills, five knitting mills, four fish canneries, two paper factories, one vegetable cannery, and one factory making silk thread. Two of the fish canneries also did some vegetable canning.

---

[1] **Family Living on Poorer and Better Soil,** Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 320 (State College, 1937).

Occupations of Sons and Daughters of Mississippi Cotton Farmers, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 318 (State College, 1937).

[2] The eight bases for classification of counties into the group least suitable for permanent arable agriculture are given in "Current and Recent Land Occupancy with Particular Reference to Land Use." Land Use Planning Section, Land Utilization Division, Farm Security Administration, by C. O. Henderson, June 15, 1936.

Choice of plants. From the lists of plants available, the following were selected for this study: The textile mills in Attala, Clarke, and Lauderdale Counties and the garment plants in Itawamba and Forrest Counties. This study was limited to two industries, because preliminary testing indicated that the situation of workers in the different industries varied and these two types of industry offered very interesting contrasts. Employed in the five plants were about 1000 white women: 500 textile and 500 garment plant workers. This was the number which the preliminary study had shown necessary for furnishing the minimum number of cases desired; that is, 300 cases. The plants were fairly widely distributed over the State, located in villages as well as in small cities, and financed by Mississippi as well as out-of-State capital. (See figure 1 for location of plants of the study.)

Choice of rural areas. It was estimated that a random sample of one-fourth of the homes in a 10-mile radius of the five plants would yield a sufficient number of farm women with whom the factory group could be compared.

To get a random sample of one-fourth of the farm homes, it was necessary to obtain maps for each 10-mile area surrounding the five plants, showing the network of roads and the location of farm homes. United States post office maps and Tennessee-Tombigbee survey quadrangle sheets were used, except in the case of the area around Kosciusko, the town in which the Attala County plant was located, and in the case of a small portion of the area around the Itawamba County plant. Such maps were not available for these areas. Here landowners' maps made from tax rolls were used, and the network of roads and the location of farm houses filled in. These maps, being of later date, were somewhat more accurate than were the post office maps and quadrangle sheets. It was found that ownership of land offered an additional check on location of houses.

In selecting the farm localities for study, the cities, towns, and villages were first blocked out on the map. Then the farm areas remaining were divided into a large number of small subdivisions, each including from 15 to 20 houses (see fig. 2, which shows a section of one of the farm areas studied and how sampling was done). The number of houses in each subdivision varied somewhat since boundaries of subdivisions depended upon

MISSISSIPPI, 1933

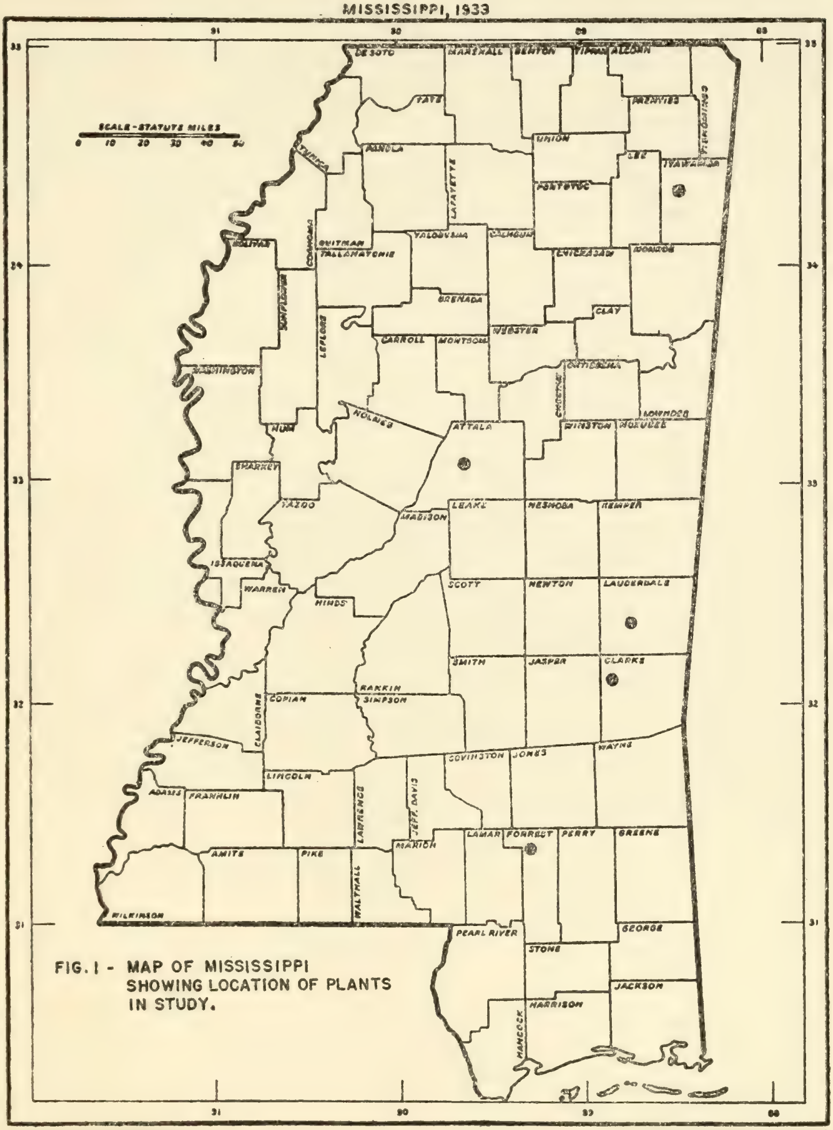
SCALE-STATUTE MILES
0 10 20 30 40 50
DE SOTO
MARSHALL
BENTON
TIPPAH
ALCORN
TISHOMINGO
TATE
PRENTISS
TUNICA
PANOLA
UNION
LEE
ITAWAMBA
LAFAYETTE
PONTOTOC
COAHOMA
QUITMAN
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
BOLIVAR
SUNFLOWER
GRENADA
CLAY
LEFLORE
CARROLL
MONTGOMERY
WEBSTER
WASHINGTON
OKTIBBEHA
CHOCTAW
LOWNDES
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
ISSAQUENA
WARREN
HINDS
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
RANKIN
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
COVINGTON
JONES
WAYNE
LINCOLN
JEFF. DAVIS
ADAMS
FRANKLIN
LAWRENCE
LAMAR
FORREST
PERRY
GREENE
AMITE
PIKE
MARION
WALTHALL
WILKINSON
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
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FIG. I - MAP OF MISSISSIPPI SHOWING LOCATION OF PLANTS IN STUDY.

U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF AGRICULTURAL ECONOMICS

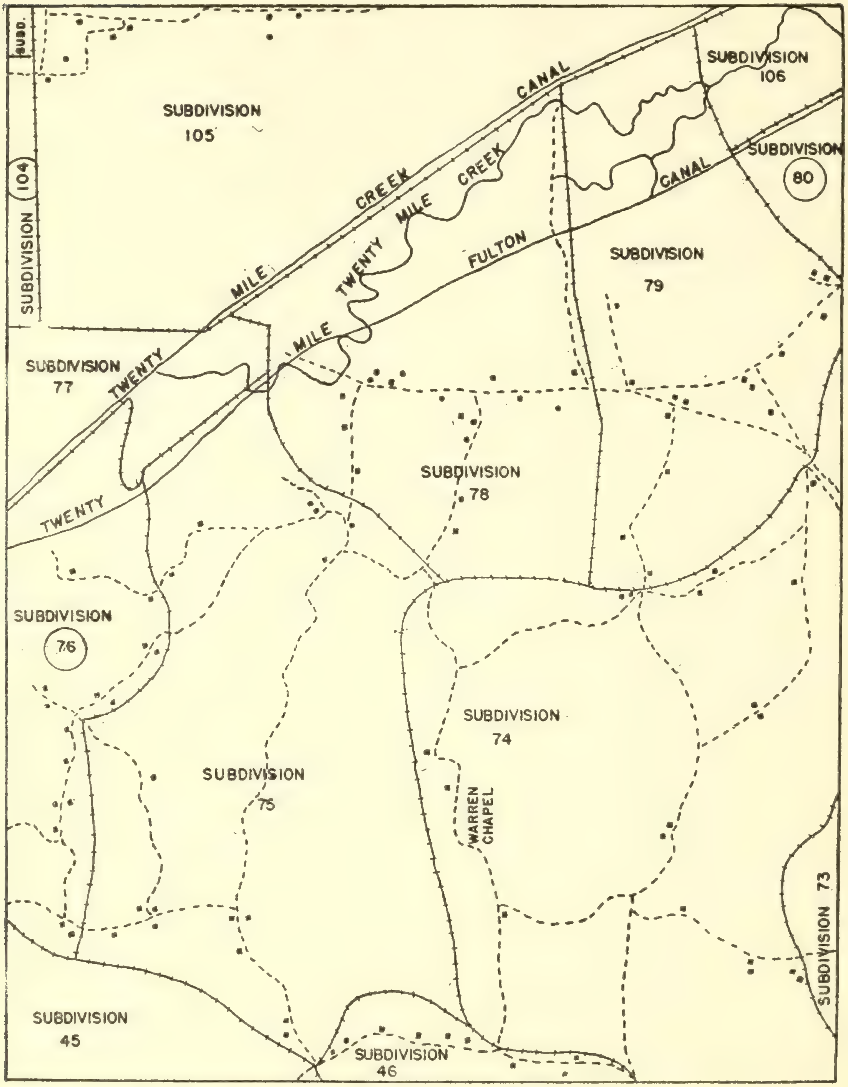
SUBD.
SUBDIVISION 104
SUBDIVISION 105
CANAL
CREEK
MILE
TWENTY
TWENTY MILE CREEK
SUBDIVISION 106
SUBDIVISION 80
CANAL
FULTON
SUBDIVISION 79
SUBDIVISION 77
TWENTY MILE
TWENTY
SUBDIVISION 78
SUBDIVISION 76
SUBDIVISION 74
SUBDIVISION 75
WARREN CHAPEL
SUBDIVISION 73
SUBDIVISION 45
SUBDIVISION 46

FIGURE II. A SECTION OF ONE OF THE FARM AREAS OF THE STUDY WHICH ILLUSTRATES HOW SAMPLING WAS DONE. ALL HOUSES IN ENCIRCLED AREAS WERE VISITED.

LEGEND

- - - - ROADS

• • • • • • HOUSES

——+—— CREEKS, CANALS, OR RIVERS

—+—+—+— SUBDIVISIONS

roads, creeks, and other landmarks. The subdivisions were then numbered consecutively, working back and forth from one side of the circle to the other. After the subdivisions were numbered, every fourth subdivision was marked to be included in the sample, beginning with the number drawn from four slips of paper numbered 1 to 4.

Choice of subjects. The eligibility requirements of the factory women included in the study were as follows: (1) The families in which the women were reared must have derived as much or more of their income from farming than from any other occupation while the women resided with them; (2) the women must be between 17 and 35 years of age; (3) the women must have worked in the factory 12 months or more during the past 2 years. The eligibility requirements of the farm women to be used in comparison with the factory group were as follows: (1) The families in which they were reared must have derived as much or more of their income from farming as from any other occupation when the women resided with them; (2) the women must have been from 17 through 35 years of age; (3) the women must not have had more than 149 days of gainful non-farm employment during the past year, or have been a student during the past year; (4) the head of the family with whom they resided must have operated a farm during the past year; (5) the women must have ordinarily assisted in the production of one or more farm products offered for sale.

The factory group included all women employed in the five plants at the time of the study, meeting all eligibility requirements for the factory sample. As residence was not one of the eligibility requirements, they might live on farms or in towns. The farm women included women residing in a random sample of rural areas around the five plants and meeting all eligibility requirements for the farm sample. The eligibility requirements eliminated the possibility of including the same woman in the farm and in the factory sample, but it was possible for a farm woman to meet all the eligibility requirements of the factory sample except employment at the time of the study. An example is: the woman who had assisted on the farm during the past year and had worked the entire previous year at the factory. Such a case, however, did not occur in the study.[3]

Preliminary study indicated that practically all the women in the garment plants were between 17 and 35 years of age; nearly three-fourths of the women in textile mills were of this age group. Since the number of industrial women available for such a study was limited, it was decided to base the study upon the age characteristics of the industrial group and to select the farm sample to correspond, as the supply of farm women available in all groups was abundant.

---

[3] There were, however, among the schedules obtained from farm women 12 from women who had previously done textile mill work; 28 from women who had previously done garment plant work. The farm family with wife having had textile mill experience resembled the non-owner farm family of the study. The farm family with the wife having had garment plant experience resembled more the owner farm family of the study, but was smaller and more likely to have certain household conveniences.

Collection of the data. The data for the study were collected by personal interviews, using schedules and methods of the Consumer Purchases Study for obtaining family income and expenditures.[4] Schedules for obtaining other data were evolved through preliminary testing. The schedules of all eligible factory and farm women were filled out by one person, the investigator. Some assistance was used, however, for interviewing to fill out the short schedules. These schedules determined whether or not the woman was eligible for the study and covered all white industrial workers in the five plants and all white women in the random sample of rural areas in a 10-mile radius of the five plants. The field work was done in the period from January 1938 to January 1940. The preliminary study was made in the fall of 1937.

Lists of white women employed in industrial work were obtained from the manager of each plant, and the women were interviewed at home.[5] Visiting the homes of the garment plant women was more of a task because fewer of them lived in close vicinity to the plants. All three textile mills had company houses in which many of their employees resided. This was not true of the garment plants.

DESCRIPTION OF THE PLANTS, RURAL AREAS AND SUBJECTS FROM WHICH THE SAMPLE WAS SELECTED

The Plants

The Clarke County textile mill, the oldest of the group, began operation in 1868, soon after the War between the States. The Lauderdale mill followed sometime afterwards, in 1903, while the Attala mill was founded shortly after the boll weevil entered the State. With the plantation system upset by the emancipation of slaves, with the distressed condition of the agricultural economy, and with the South's inability to gain ground politically during Reconstruction days, manufacturing seemed to provide the escape. New inventions favored cotton manufacturing in the South. There were certain geographical advantages to locating these industries in this region.

The garment plants of the study were both started during the world-wide business depression in 1932-33, a time when unemployed workers and impoverished farmers purchased work clothing instead of suits of clothes and when rural young women "backed up" on farms were in great need of increased opportunity for earning.

The Clarke County mill had around 700 employees, the Attala County mill about 450 and the Lauderdale County mill about 200 (table 1). These included "spare hands" (those who take the place of absent workers so that machines need not stand idle nor production be interfered with) as well as those with regular jobs. Forty-one percent of the textile mill employees were white women engaged in industrial work. Relatively more women than men were employed at the Lauderdale plant where it was said, "Women work better, are quicker, are more careful." This mill was on the edge of a small city where there were more work opportunities than around the other two mills. For the wages paid, better women than men workers could be obtained, no doubt.

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[4] See "Consumer Incomes in the United States," Report, National Resources Committee, Aug. 1938, pp. 40-52, and "Consumer Expenditures in the United States," Report, National Resources Committee, Mar. 1939, pp. 109-119.

[5] In some cases the information was obtained from the husband or mother.

Table I. Number of employees in the three textile mills and two garment plants included in the study

Kind and location of plant	White women employed for manufacturing	All other employees	Total employees
	Number	Number	Number
Textile mills			
Attala County	162	272	434
Clarke County	284	422	706
Lauderdale County	93	106	199
Total	539	800	1339
Garment plants			
Forrest County	383	90	473
Itawamba County	173	6	179
Total	556	96	652

The employees in the garment plants were predominately white women engaged in manufacturing (table 1). The Itawamba plant, in which no cutting was done, and where the women did the pressing, used only six men. Eighty-one percent of the employees of the Forrest County plant were white women engaged in industrial work.

Several white women were employed as clerical workers; several negro women to clean. This means that the "all other" group in table 1 was largely composed of male employees and for the most part of white semi-skilled and skilled factory hands. Negro men were not used to any extent in the plants of this study.

Most of the women in the textile mills worked in the spinning department or in the "weave shop." Those in the weave shop were principally "battery hands," which operation consists in placing the filling bobbins on the automatic loom battery. Comparatively few were weavers. The majority of the women in the garment plants were sewing machine operators, each worker specializing in one or at the most a few operations. In the textile mills, cotton cloth was made. Shirts were manufactured in both garment plants. The Forrest County plant, in addition, manufactured work pants.

The studies in the plants located in Attala, Clarke and Itawamba Counties were completed before October 1938, at which time the Fair Labor Standards Act went into effect. Before this Act went into effect, 60 hours a week was the maximum working time permitted females engaged in industrial work in Mississippi. These were the hours of the women employed in the two textile mills. This schedule was not followed for long periods, however, by the majority of these textile mill women, because time was lost from shut-downs and slack work. The hours worked by the women in the Itawamba garment plant were within the limit of 44 hours per week set by the Fair Labor Standards Act.

The Rural Areas

Table 2 shows the number of families in the random sample of rural areas. The sample around each plant included some land from an adjacent county, and the Forrest plant included land from four adjacent counties. The fact that a 10-mile radius, rather than the county, was used as a basis for selection of the sample makes comparison with the census material impossible. It is believed, however, that a representative sample was obtained, as homes in valleys and on hill slopes, near and far away from water courses, and near and at a distance from high roads and shopping centers, were visited.

Table 2. Number of families in the random sample of rural areas around the three textile mills and two garment plants

Location of random sample of rural areas	No. families in random sample in rural areas White families	Negro families	All families
Around textile plants			
Attala County	264	316	580
Clarke County	246	221	467
Lauderdale County	258	238	496
Total	768	775	1543
Around garment plants			
Forrest County	366	167	533
Itawamba County	694	49	743
Total	1060	216	1276

The number of families in the random sample of rural areas around the plants varied considerably. This was because there were more subdivisions around some plants than others. There were fewer subdivisions in a 10-mile radius of the Clarke County plant because this area contained four towns or villages that were blocked off before marking subdivisions. In this area there was also a public park, much wooded land, and a fishing club, all of which meant sparse population. There were more subdivisions around the Itawamba County plant because there was only one small village in a 10-mile radius of the plant to be blocked off.

Seven hundred and sixty-eight white families were included in the random sample of rural areas around the cotton mills, while 1060 white families were included in the random sample of rural areas around the garment plants (table 2). The women in the farm study were, therefore, selected from 1828 families. The sample around the garment plants was larger, of course, because there were more white people in those areas.

The Women in Textile Mills and Garment Plants

Information which determined eligibility for the study was obtained from 538 of the 539 women in the three textile mills and 544 of the 556 women in the two garment plants, or a total of 1082 women industrially employed.[6] One hundred and seventy of the textile mill women (about one third) and 249 of the garment plant women (about one-half) met all three eligibility requirements. Seventy-one percent of the women in textile mills and 94 percent of those in garment plants were 17 to 35 years of age. Eighty-four percent of the textile mill women and 79 percent of the garment plant women had worked in their respective industries for 12 months or more during the past 24 months. Fifty-nine percent of the textile mill women had parental families whose main occupation had been farming when they resided with them. Sixty-five percent of the garment plant women came within this category.

The Women in Rural Areas

Information which determined eligibility for the study was obtained from all women of 16 years and over included in the 1828 white families in the random sample of rural areas around the five plants.[7] Five hundred and forty-one of the 2576 thus included, which is about one-fifth, met all the eligibility requirements of the study. This is a smaller proportion than in the case of factory women meeting the eligibility requirements for the study, but this is to be expected, since the eligibility requirements were based more on the characteristics of industrial women than of farm women.

Fifty-two percent of the women in rural areas were ineligible for the study because of age. Nearly one-half could not be classified as farm women, for during the report year they had either been employed in gainful nonfarm work more than 149 days, or had been students, or had not resided in the homes of families, the heads of which were farmers, or had not assisted in the production of one or more farm products offered for sale. Only 10 percent of the women in these rural areas failed to meet the third eligibility requirement, that of having been reared in the home of a farmer.

MARITAL STATUS OF WOMEN MEETING ELIGIBILITY REQUIREMENTS OF STUDY

Although the 394 women assisting in textile mills and garment plants[8] and the 529 assisting on farms[9] were in the same age group and of the same family background, they differed quite considerably in marital status (table 3). Garment plant women and farm women whose family heads were farm owners were much more likely to be single than were textile mill women and farm women whose family heads were farm non-owners. This was because the former did not marry as young as did the latter.

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[6] One woman in the textile mills, and 11 in the garment plants refused to give the information. We were unable to contact one woman in a garment plant. For a comparison of the 538 textile mill women and the 544 garment plant women, see "Some Contrasts in Women Employed in Two Types of Industries in Mississippi," Dorothy Dickins, Social Forces, Vol. 19, No. 4, pp. 522-532, May 1941.

[7] About two-thirds of the families had one woman only; one-fourth had two women; less than 10 percent had more than two women.

[8] Detailed data on income and expenditures were not obtained from 25 of the 249 eligible garment plant women. Twenty-three refused to give this information and two women could not be re-contacted. The names of those refusing were checked with the pay roll clerk of the plant where all those refusing worked. According to her, those refusing were rather typical of the group.

Table 3. Marital status of factory and farm women meeting eligibility requirements of the study

Marital status	Factory women			Farm women		
	Textile mill	Garment plant	Total	Head of family* Owner	Head of family* Non-owner	Total
	No.	No.	No.	No.	No.	No.
Married	120	106	226	103	265	368
Single	37	106	143	86	65	151
Widowed	1	2	3	1	1	2
Divorced and separated	12	10	22	3	5	8
Total	170	224	394	193	336	529
			Percentage distribution			
Married	70.6	47.3	57.4	53.4	78.9	69.6
Single	21.7	47.3	36.3	44.6	19.3	28.6
Widowed	.6	.8	.7	.5	.3	.3
Divorced and separated	7.1	4.6	5.6	1.5	1.5	1.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Husband or father.

More industrial women than farm women were divorced and separated (table 3). Because of special need for work, divorced and separated women had no doubt sought employment more than had married and single women. Then, too, in some cases employment in industry may have made practicable termination of unsatisfactory marriages.

There were relatively nearly two times more divorced and separated textile mill women than garment plant women. The environment of the textile mills was no doubt more conducive to divorce or separation than was the environment of the garment plants. Women employed in textile mills worked with men. The majority lived in mill villages. Only 6 percent were married to farmers. There were few men employed in the garment plants. Many of the garment plant women lived in the country and came to work each day in automobiles or busses. Thirty-five percent of the married garment plant women were married to farmers. Divorce and separation are, of course, less common among rural people than among non-farm and among urban people.

Married Women

Two hundred and twenty-six of the factory women and 368 of the farm women were married. The majority in both groups had been married a year or more and had kept house during the entire report year, but the percentage was greater in the case of farm women. Thirty-six percent of the married factory women had not kept house a year with their husbands. Only 8 percent of the married farm women came in this category. The 81 married women in this group will not be included in the analysis of married housekeeping women and their families which is to follow. Before proceeding with this analysis, however, some information will be given with respect to the women who will be excluded, those married less than a year, and those married more than a year but not keeping house during the entire report year.

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[9] Detailed data on income and expenditures were not obtained from 12 of the 541 eligible farm women. Several husbands could not be re-contacted to complete the schedules. Only two refused to cooperate.

Women Married Less Than a Year

In the group married less than a year were two textile mill women, 24 garment plant women, and 10 farm women (7 daughters of non-owners and 3 daughters of owners). Why did relatively more garment plant girls marry during the year than did farm daughters without gainful work? This question was repeatedly asked, for the difference in the number marrying was noticed during schedule taking. These are some of the replies obtained concerning the few marriages of non-gainfully employed farmers' daughters to farmers: "Young men can't get farms . . . " "Young men are wise these days and get on the WPA instead of the farm. When one operates a farm[10] he is taken off WPA during crop season and it is hard to get back on. WPA more profitable in these areas than farming . . . " "Young men are given WPA work as more adaptable to that type of work than are older men. Older men do the farming." These are some of the replies obtained concerning greater frequency of marriage of the garment plant girls: "They make enough to support a husband . . ." "Their jobs make marriage possible."[11]

It is possible that there are fewer farmers to marry because of the activities of the AAA as well as of the WPA, but verification of this fact awaits a classification of white farm operators by marital status from data of the 1940 Census of Agriculture. The garment plant girl, because she had more opportunities for meeting nonfarmers, was more likely to marry than was the farm girl without gainful work.

There are, however, other explanations for this difference in the number marrying during the schedule year. More garment plant girls than farm girls marry between the ages of 17 to 35 years. Farm assistants more frequently marry before they are 17 years of age than do industrially employed girls. In the random sample of rural areas around the five plants, there were four married farm women of 16 years of age. Only one married factory woman was as young.[12]

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[10] The census definition of a farm operator was used in this study.

[11] Six of the garment plant workers who were married during the report year married farmers. This is somewhat less than the proportion of garment plant workers with farmer husbands.

[12] Girls under 17 years were ineligible for the study, but certain data concerning girls of 16 years were obtained.

Newly established families had lower incomes as well as lower expenses. There was one budgetary item, however, for which these families spent more than did the longer established family; namely, more for household equipment and furnishings. As a rule, the newly married couple, whether farm or factory, began their married life rooming and boarding, although the factory woman was more likely to continue this practice (the textile worker more likely than was the garment plant worker) than was the farm woman. Pregnancy usually led the farm woman to set up housekeeping, and this occurred generally the first year of married life.

Part or all of what was cleared from the first crop was generally used to buy housekeeping equipment by the farming couple. They were not as likely to go in debt for such equipment, or if they did, for not as great an amount as was the newly-wed factory couple. The parental families of the farm couple, as a rule, contributed more household equipment to their recently married children than did the parental families of the couple in which the wife was industrially employed, no doubt because the former needed it more.

As will be noted in table 4, the household equipment purchased by farm couples was much less than that purchased by couples where the wife was engaged in factory work. Greater expenditures by young couples in which the wife was industrially employed, however, did not always result in more attractive homes. Some of the furniture and furnishings bought by these young wives was of the "ginger bread and red plush" type. The majority had had little training or experience in the use of the dollar for furnishing a home and were easy victims of persuasive salesmen.

Table 4. Housekeeping equipment purchased by factory and farm couples

Group	Equipment purchased	Total cash expenditure
		(Dollars)
One of the most well-to-do factory couples	Bedroom suite, living room suite, stove, breakfast room set, 3 rugs and dishes purchased second-hand. Dining room suite, cabinet, curtains, and towels purchased new	267.50
One of the most well-to-do farm couples	A cot, iron bedstead, springs, 4 straight chairs, dresser, dining table, cooking utensils, and bedding purchased new	115.00
One of the least well-to-do factory couples	(Wife already owned a bedroom suite) Stove, chairs, shades, and rug purchased new	50.50
One of the least well-to-do farm couples	Cooking utensils, dishes, and straight chairs purchased new. Stove purchased second-hand. (Parents gave bedstead and dresser)	25.00

Nonhousekeeping Women Married More Than a Year

In this group of women married more than a year but not having kept house the entire report year, there were relatively six times more textile mill women and four times more garment plant women than farm women. This is not surprising, for factory women who keep house are doing double duty, and especially factory women working 10 hours a day as were some of the textile workers in this study. Yet the majority of the nonhousekeeping factory women looked forward to keeping house at some time in the future. One-fourth was definitely saving to go into housekeeping. Six of the 34 started housekeeping during the schedule year. The 11 farm nonhousekeepers who roomed and boarded part or all the schedule year were with three exceptions definitely planning, or had already started, housekeeping.

The per capita incomes of the families of nonhousekeeping women were on the whole greater than were those of families of housekeeping women because of smaller families of nonhousekeeping women, not because of larger incomes. Incomes of families of factory as well as those of farm nonhousekeepers varied considerably. Some of the nonhousekeepers and their families were supported in large part by relatives; others themselves supported relatives.

Widowed, Divorced, and Separated Women

There were only 25 factory and 10 farm widowed, divorced, and separated women eligible for the study (table 3) and all except five of these were divorced or separated. These divorced and separated women had married earlier than had the married women eligible for the study. This was even more true of farm divorced and separated than of factory divorced and separated women. Thirty-six percent of the divorced and separated factory women married before they were 18 years of age; only 30 percent of the married factory women were married so early. Seventy percent of the divorced and separated farm women married before they were 18 years of age; only 46 percent of the married farm women were married so early. Early marriage accounts no doubt for some of the divorces and separations. The divorced and separated women were the group of women with less schooling. Their education was of course interrupted by marriage. The community, it would seem, should make greater effort to provide wholesome recreational activities for its young people. Such activities would no doubt reduce the number of early marriages.

About one-third of the farm and factory widowed, divorced, and separated women had no children, but 30 percent of this farm group and 4 percent of this factory group had more than two children. All farm women in this group, except one, resided with their parental families and assisted with farm work. This woman, the one exception, owned and operated her own farm. About 50 percent of the industrial women in this group lived at home, the remainder roomed and boarded with unrelated persons or kept house. Their earnings were on the whole greater than were the earnings of single factory women.

Single Women

Included in the sample selected for special study were 143 single factory women and 151 single farm women (table 3). Since a whole division of the more detailed analysis is to be devoted to these groups, further discussion is not needed at this point.

SOME CONTRASTS IN LEVELS OF LIVING OF HOUSEKEEPING MARRIED WOMEN ENGAGED IN FARM, TEXTILE MILL, AND GARMENT PLANT WORK

Family Composition

Included in the group of housekeeping married women are 97 textile mill women, 69 garment plant women, and 347 farm women—100 with farm owner husbands and 247 with farm non-owner husbands. All of them had been married at least 1 year, had kept house the entire report year, and were between 17 and 35 years of age. All were farm reared.

The farm women had more children than did the industrially employed women, and the textile mill women had more children than did the garment plant women. The wives of farm owners had a mean average of 2.4 children; the wives of non-owners had a mean average of 2.6 children. The women in textile mills averaged 2.1 children; those in garment plants .9 child.[13] Nearly one-half the garment plant women had no children. Only 1.5 percent had more than three children, while 23 percent of the farm women with owner husbands and 28 percent with non-owner husbands had more than three children. Nearly 19 percent of the textile mill women had more than three children (figure 3). One explanation for the difference in the number of children of farm and industrial women no doubt lies in the fact that women with large families do not find it practicable to work away from home. Especially is this true of farmers' wives who must go into town to work.

Six percent of these textile mill women and 40 percent of these garment plant women were married to farmers. Many of the textile mill women with children lived in company houses and could thus be quickly summoned home. This, no doubt, made them more willing to leave their children. Then, too, more of the textile mill women lived in an environment where women with young children ordinarily worked. Of the 84 textile mill women with one or more children 14 years of age and under living with them, 25 left their children in the care of the grandmother, 31 in the care of hired help, 6 in the care of the father, 3 in the care of neighbors, 6 in the care of relatives other than the grandmother, and 13 in the care of no one. Of the 37 garment plant women with one or more children 14 years and under living with them, 14 left their children in the care of the grandmother, 10 in the care of hired help, 8 in the care of the father, one in the care of neighbors, and 4 in the care of no one.

Farm women ordinarily have more children than do nonfarm women. The farm business and household are closely related and this makes it possible for the children as well as the wife to add to the farm family income. The money cost of rearing children on a farm is of course less than the

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[13] The average deviation of number of children of farm owner women from their mean number was 1.7 children, of farm non-owner women 2.1 children, of textile mill women 1.4 children, and of garment plant women 1.1 children.

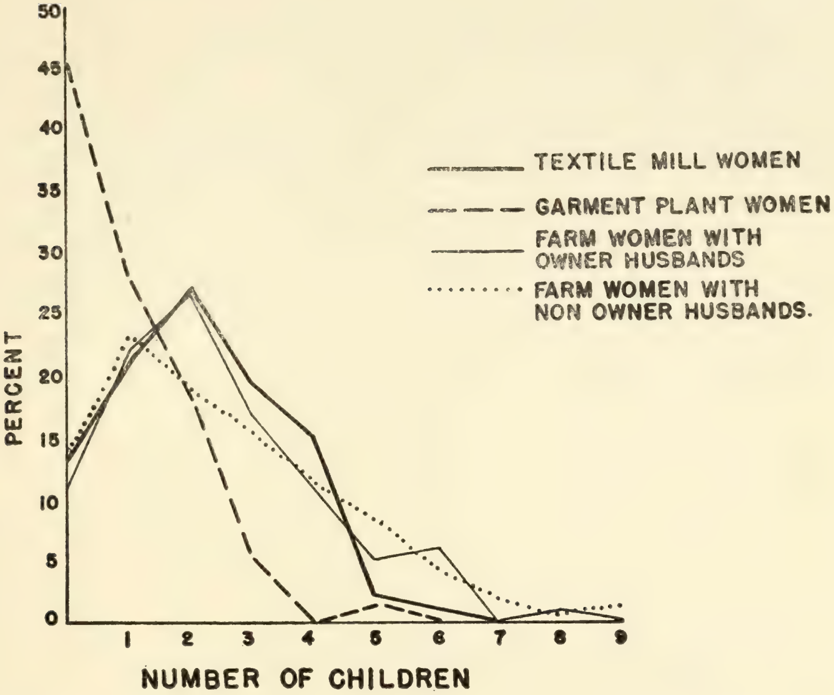

Fig. 3.—Percentage distribution of families of textile mill women, garment plant women, and farm women with owner and with non-owner husbands by number of children.

cost of rearing them in town. The differences in the number of children of the women in the four groups can be attributed only in small part to differences in ages of the women, the median age being 28 years for textile mill women, 27 years for garment plant women, 30 years for farm women with owner husbands, and 27 years for farm women with non-owner husbands.

Family Incomes

Income included, as in the Consumer Purchases Study, the total net money incomes received during the year by all members of the economic family from all sources, plus the value of the occupancy of homes of farm families and the net value of occupancy of owned homes of industrial families, the value of home-grown food and other farm products used by the family and the value of inventory change in livestock and crops stored for sale. As is shown in table 5, incomes of textile mill women and their families averaged $965; incomes of garment plant women and their families averaged $907. Incomes of families of farm women with owner husbands averaged $790; incomes of families of farm women with non-owner husbands averaged $515. Because the families of garment plant women were smaller, income per family member of this group was greater than was income per family member of the textile group. Income per family member was for the families of textile mill women $224; for the families of garment plant women $313.[14]

Table 5. Incomes of textile mill, garment plant, and farm women and their families—classified by sources from which the income derived—1938-39

Source of income	Average income per family of			
			Farm women's families	
	97 textile women's families	69 garment women's families	100 wives of farm owners	247 wives of farm non-owners
	Dollars	Dollars	Dollars	Dollars
1. Net money income	864	752	363	197
a. Earnings of wife other than home farm	360	402	4	......*
b. Earnings of husband other than farm operation	494	302	137	84
c. Earnings of children other than home farm	3	......*	......*	2
d. Net cash income from farm operation	7	29	205	98
e. All other money income	*	19	17	13
2. Non-money income	101	155	427	318
a. Value of housing	9	34	50	37
b. Value of food	86	103	294	232
c. Value of all other non-money income**	6	18	83	49
3. Total income	965	907	790	515
4. Income per family member	224	313	172	111

*Less than 50 cents.

**Includes increase or decrease in livestock or crops stored for sale, value of fuel and other products furnished by the farm.

Since a few very low income families or a few very high income families can affect averages greatly, it is important to know not only average incomes, but also how these incomes were distributed among the four groups of families concerned. This information is given in table 6 and figure 4. As may be noted, families of farm women with non-owner husbands had incomes most frequently of $250-$499 and families of farm women with owner husbands had incomes most frequently of $500-$749. Families of textile mill women most frequently had incomes of $750-$999. There were as many families of garment plant women with incomes of $500-$749 as with incomes of $750-$999. The median income (the figure that marks the dividing line between the upper and lower halves of the distribution of families by income) was $906 for families of textile mill women, $802 for families of garment plant women, $723 for families of farm women with owner husbands and $477 for families of farm women with non-owner husbands. Although the incomes of families of farm women with owner husbands were on the whole lower than the incomes of families of women in the two industries, the highest income made by a family in this study was made by a family of a farm woman with an owner husband.

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[14] Rating each person who was a member of the economic family for one month as .0833 person, a member for 12 months as 1.0 person. On this basis families of textile mill women averaged 4.3 persons, of garment plant women 2.9 persons, of farm women with owner husbands 4.6 persons, and of farm women with non-owner husbands 4.6 persons.

Table 6. Percentage distribution of families of textile mill women, garment plant women, and farm women with owner and non-owner husbands by income

Family income class	Families of textile mill women	Families of garment plant women	Families of farm women	
			With owner husbands	With non-owner husbands
(dollars)	(percent)	(percent)	(percent)	(percent)
249 or less	0.0	0.0	1.0	7.3
250-499	4.1	5.8	16.0	47.3
500-749	23.7	30.4	37.0	32.0
750-999	31.9	30.4	22.0	8.5
1000-1249	23.7	20.3	13.0	3.2
1250-1490	9.3	8.7	6.0	1.2
1500-1749	5.2	1.4	3.0	.4
1750-1999	2.1	1.4	.0	.0
2000 and over	.0	1.4	2.0	.0
Number families	97	69	100	247

The 513 families with which this discussion is concerned had two kinds of income—money income or income in the form of dollars and cents, and non-money income in the form of goods and services. A larger proportion of the income of families of industrially employed women was in the form of money income than was the case of families of farm women. Ninety percent of the income of textile women's families and 83 percent of the income of garment plant women's families was in this form. Forty-six percent of the income of families of farm women with owner husbands and 38 percent of the income of the families of farm women with non-owner husbands was in the form of money income. There was, therefore, more difference in the composition of the income of these four groups than in the total amount.

Money Income

The average money income of the families of the women in industrial work was about four times greater than that of families of farm women with non-owner husbands and twice as great as that of families of farm women with owner husbands (table 5). The median net money income for families of women in textile mill work was $836; for families of women in garment plant work, $650; for families of farm women with owner husbands, $282; and for families of farm women with non-owner husbands, $169. Two percent of the families of textile mill women, 6 percent of the families of garment plant women, 54 percent of the families of farm women with owner

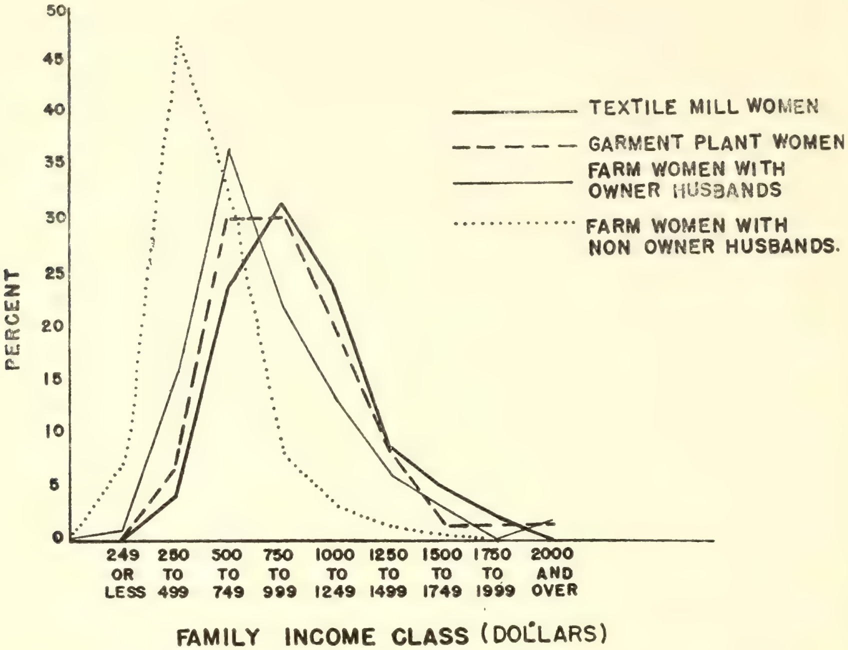

Fig. 4.—Percentage distribution of families of textile mill women, garment plant women, and farm women with owner and with non-owner husbands by income.

husbands, and 84 percent of the farm women with non-owner husbands had less than $300 net money income during the report year.

About one-half of the money income of families of industrially employed women was earned by them (table 5). Garment plant women earned on an average more than did textile mill women, due to the fact that they lost less time from work because of shut-downs, short time, sickness of themselves or members of their families. There was, however, a greater variation in cash earnings of textile mill women than in the earnings of garment plant women. Several in the textile group earned less than $100 during the report year, because they had but recently returned to work after an absence of several months to have a baby. There were, however, several who earned more than $600. Forty-six percent of the garment plant women and 37 percent of the textile mill women earned $400 or more.

The cash earnings of the farm women with owner husbands averaged $4 per woman and the earnings of those with non-owner husbands averaged less than 50 cents per woman. Most of the farm women of the study, however, had young children and hence little time to carry on activities that would bring in additional cash. As the children grow older, the women will have more time for additional activities as well as more need for cash. About one-fifth of the farm women had done nonfarm work since leaving school.

Nearly three-fourths of the husbands of textile mill women were themselves engaged in textile mill work. The remainder were engaged in other types of unskilled, semi-skilled or skilled wage work. Farming was the main occupation of only six of the husbands of these women, though two husbands operated farms as a side line. About 40 percent of the husbands of garment plant women were farmers. The remainder were engaged principally in unskilled, semi-skilled and skilled wage work. The husbands of farm women were, by definition, farmers. Forty-seven percent of the non-owner husbands were share renters, 38 percent were sharecroppers, and 15 percent were cash renters.

As may be noted from table 5, husbands of textile mill women earned an average of $494 in work "other than farm operation." Those of garment plant women earned an average of $302. Owner husbands of farm women earned an average of $137 for work off the farm. Such earnings of non-owner husbands of farm women averaged $84. The farm owner may be more capable of doing the extra jobs to be found in the neighborhood. Then, too, he may have more influence and for this reason may more easily secure such jobs as are available. Only two husbands, one the husband of a textile mill woman, the other the husband of a garment plant woman, did not earn during the report year. Both of these men were incapacitated.

The earnings of the children of the women in these four groups were almost negligible. The children were in the main young children, for none of the women in the study was over 35 years of age. Children earned in about one out of every 50 homes of garment plant women and of farm women with owner husbands; in about one out of every 20 homes of textile mill women; and in about one out of every 12 homes of farm women with non-owner husbands. The most frequent methods of earning by the children of the farm women of non-owner husbands were chopping and picking cotton for neighbors.

Families of farm women with owner husbands earned $205 from farm operation. This was more than was earned in this manner by the other three groups (table 5). An average of about $75 per family was netted from farm operation by families of garment plant women with farmer husbands. This was $66 less than was netted by a similar group of farm families where the wife assisted at home on the farm instead of working in the factory.[15]

Forty percent of the families of garment plant women with farmer husbands and 29 percent of the families of farm women owned their farms. Several of the garment plant women were assisting their husbands in buying a farm; several, in holding a farm about to be lost because of failure to meet payments. On the other hand, several of the garment plant women, tired of assisting in the financing of an unprofitable farm, such as were many in these areas, had induced their husbands to give up farming and move to town.

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[15] Acreage in cultivation by the farmer with wife in industry was about the same as the farmer with wife assisting at home, but the farm expenses of the farmer with wife in industry were greater.

One of the arguments often used for an industrial program is that it results in more markets for the products of those remaining on farms. Several of the farm families in this study sold vegetables, corn meal, sirup, meat, and fuel to industrial families. This was usually done by farm owner families who were more skilled in food production and had more capital to buy the equipment and materials needed for such production. A number of industrial families purchased all their foods from the "company store," or from a store nearby where they could get credit. This practice reduced to some extent the market for those on nearby farms.

Non-Money Income

Non-money income of families of women in industrial work was considerably less than of families of women in farm work (table 5). The non-money income of families of farm women with owner husbands was four times the non-money income of families of textile mill women, and three times the non-money income of families of garment plant women. Non-money income of families of farm women with owner husbands was about one-fourth more than such income of families of farm women with non-owner husbands.

The median non-money income was for families with wife in textile mill work, $52; for families with wife in garment plant work, $148. The difference in the non-money income of families of textile mill and garment plant women can be explained by differences in number owning homes in the two groups. More of the husbands of garment plant women were farmers, and farmers raise products for home consumption more than do non-farmers.

Farm women with owner husbands had a median non-money income of $417; those farm women with non-owner husbands had a median non-money income of $320. Yet, families of farm women with non-owner husbands having lower net money incomes than those with owner husbands and averaging the same number of persons in the economic family, needed higher non-money incomes to make up the differences. Evidently the same factors that are responsible for a higher money income are responsible for a higher non-money income.

In table 5 is given the average value of housing for the four types of families. Value of housing, as previously stated, included value of the occupancy of homes of farm families and the net value of occupancy of owned homes of nonfarm families.[16] Forty-five percent of the families of garment plant women, 22 percent of the families of textile mill women, and 29 percent of the families of farm women owned their homes. Average value of housing for those owning homes was for families of textile mill women, $41; for families of garment plant women, $57; for families of farm women with owner husbands, $50; and for families of farm women with non-owner husbands, $37. In other words, families of women in garment plants who owned their homes lived in somewhat better houses than home-owning families in the other three groups. Families of farm women with non-owner husbands were the most poorly housed of the study. Eighty-nine percent lived in houses valued at less than $500; three of these families lived in houses valued at $1000 or more. None of the families of farm women with farm-owner husbands lived in houses as valuable.

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[16] Value of housing. (a) For nonfarm families: the rental value of the owned home was ascertained. Payments of interest and expense for taxes, repairs, and insurance were deducted, giving an estimated net rental value of the owned home. (b) For farm families a modification of the procedure used in evaluating housing of nonfarm families was necessary since there was no basis for estimating the rental value of the family dwelling. Farm rent was based largely upon the value of land and buildings: owned homes, 10 percent of the estimated present value of the farm family dwelling was used as rental value. (It was estimated that this would cover a reasonable return from money invested, interest on mortgage, taxes, depreciation.) Rented homes, 12 percent of the estimated present value of the farm family dwelling was used as rental value. (This covered the items covered by owned farm homes plus insurance and repairs, since these expenses were paid by the landlord.)

There were 73 families of textile mill women and 27 families of garment plant women who had house rent to pay each month. Families of textile mill women paid, on the average, about $60 a year rent; those of garment plant women about $72 a year. This does not mean, however, that industrial families renting houses lived in better houses than industrial families owning houses. Families with free housing lived more often in the country where rental values were less. About 80 percent of the families of textile mill women who had house rent to pay lived in company houses. The others, as a rule, rented privately-owned houses which were in close vicinity to the mill, and which generally rented for more than company houses.

Families of textile mill women were most crowded (table 7). Nearly one-third of these families had two or more persons per room. Families of farm women with non-owner husbands slept as crowded as did the textile mill group. Farm families of Mississippi who can possibly arrange it have a dining room, for they entertain usually by "inviting to dinner." Many, however, who have dining rooms limit the use of them to company meals or to summer time when it is "too hot to eat in the kitchen." In some farm houses there was an unused room or two because of a limited supply of furniture.

Table 7. Amount of room space in houses of families of women engaged in textile mill, garment plant, and farm work

Item	97 families of textile mill women	69 families of garment plant women	100 families of farm women with owner husbands	247 families of farm women with non-owner husbands
	Percent having	Percent having	Percent having	Percent having
No separate living room	95	86	89	98
No separate dining room	89	63	49	70
Two or more persons per room	31	6	7	21
Four or more persons per bedroom	24	5	16	24

About three-fourths of the non-money income of families of industrial and of farm women was in the form of farm-furnished food.[17] The value of home-produced food consumed by families of farm women with owner husbands averaged $294 per family. It averaged $232 for families of farm women with non-owner husbands, $103 for families of garment plant women, and $86 for families of textile mill women. Forty-two percent of the families of textile mill women owned one or more milk cows, or had the use of one at sometime during the report year; 51 percent had one or more hens; and 65 percent one or more home-raised vegetables at sometime during this period. This surprisingly good record was due to the fact that the management in the mill, from which the majority of these married women came, provided pastures and otherwise encouraged home-production of foods. Ownership or use of at least one milk cow during the schedule year was reported by all except one of the farm women owner-families, by 94 percent of the farm women non-owner families, and by 58 percent of the garment plant women families.

The average value of food production for home-consumption by families of garment plant women with farming husbands was $200, or about $57 less than for families of farm women with husbands of similar tenure status. However, families of garment plant women with farming husbands were smaller than families of farm women. Sixty-four percent of the garment plant women had no children; only 13 percent of the farm women had no children.

About one-half of the families of textile mill women produced less than $25 worth of food during the report year. One-fifth of the families of garment plant workers had such a record. Only five families of farm women, all of them with non-owner husbands, produced as little. Four percent of the families of women in both industrial groups, 43 percent of the families of farm women with owner husbands, and 23 percent of the families of farm women with non-owner husbands produced $300 or more food for home consumption.

From the data thus far given, it cannot be determined which group of families was better off. It is true that income per family member of the families of farm women was less, but much of this income was in the form of free housing and home-produced food and fuel to which it is difficult to assign values.

Value of Family Living

The average value of family living (including cash expenses for family living, value of housing and of farm products used by the family) was for families of textile mill women, $974; for families of garment plant women,

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[17] Estimated value obtained by multiplying the quantity of products used, as reported by the family, by a price estimated for each locality. Price estimates were based upon what a sample of farm families in the locality reported they would have paid had they bought products of the same quality and in the same quantity from neighbors, or from the most likely place of purchase. This method of evaluation gives a higher figure than that obtained when valuation is based on farm prices or wholesale market prices.

$828; for families of farm women with owner husbands, $704; and for families of farm women with non-owner husbands, $525. Differences in cash expenditures for family living of the four groups were greater; $873 for families of textile mill women; $681 for families of garment plant women; $309 for families of farm women with owner husbands; and $214 for families of farm women with non-owner husbands (table a in Appendix). Cash expenditures for family living emphasize differences in composition of income rather than actual differences in manner of living.

A large part of the differences found in value of family living of the four groups of married women and their families can be attributed to differences in income and in family size and composition. In each of the four groups

Table 8. A comparison of the mean money and non-money incomes and mean cash expenditures and value of goods consumed of families of textile mill, garment plant, and farm women with total incomes of $750-$999

Item	Families of textile mill women	Families of garment plant women	Families of farm women with Owner husbands	Families of farm women with Non-owner husbands
Number of families	31	23	22	21
Mean size, no. persons	4.0	3.1	4.6	5.3
Value non-money income	$ 98	$154	$484	$516
Value food	76	107	322	366
Value housing	16	32	58	53
Value all other	6	10	30	38
Inventory change	*	5	74	59
Money income	794	658	365	320
Change in net worth**	–22	41	34	32
Total income	892	812	849	836
Cash expenditures	811	658	332	290
Food	316	218	88	101
Clothing	82	91	68	67
Housing	57	42	13	1
Household operation	115	50	21	19
Household equipment	37	35	21	9
Auto	78	76	23	19
Other travel	6	34	6	5
Recreation	9	13	9	15
Reading	5	3	2	1
Tobacco	18	16	11	11
Medical care	34	31	38	20
Personal care	15	12	9	7
Education	5	9	6	8
Gifts, community welfare, and selected taxes	10	9	12	6
All other	24	19	5	1
Money value all goods consumed	909	807	742	747
Money value all goods consumed per person per family	227	260	161	141

*Less than 50 cents.

**Changes resulting from actual money transactions.

there are unfortunately not enough families having similar incomes and composition to determine in what respects the employment of the wife affects the family-consumption pattern. There are, however, a sufficient number of cases in two income groups (see tables b and c in the Appendix). These analyses suggest that there is a relation between occupation of wife and total cash expenditures, and that this relation is more significant for families of lower than higher incomes. This hypothesis is tentative and needs further testing and refining.

Table 8 shows some of the differences in money value of goods consumed by the four groups, when income is held constant. From these figures one might conclude that the textile mill group is better off than the group of families of farm women with owner husbands; but is this true? Are money-value figures a sufficient basis from which to draw conclusions?

Food

Average weekly values of food consumed per food expenditure unit[18] ranged from $1.30 for families of farm women with non-owner husbands to $2.21 for families of garment plant women. They averaged $2.02 for families of textile mill women and $1.68 for families of farm women with owner husbands. In other words, the groups with the highest per capita income had highest money values of food consumed.

How did values of food consumed by families of the same income class in these four groups compare? Table 8 gives such information for families with incomes of $750-$999 and table c in the Appendix expresses the relationship statistically. At an income level of $750-$999, with family type held constant, there was no significant relationship between total value of food and occupation of wife; but there was a significant relationship in cash expenditures for food and occupation of wife. At an income level of $500-$749, family type held constant (see table b in the Appendix), there was a significant relationship in total value of food and occupation of wife, and a highly significant relationship in cash expenditures for food and occupation of wife.

At an income level of $750-$999, as may be noted from a study of table 8, there was little variation in total money value of food consumed by families of the four groups of women. At an income level of $500-$749, however, total money value of food was greater for families of farm women. At very low income levels, families of farm women were undoubtedly better off in respect to food than families of industrial women. This was well, for more than half of the families of these young farm women with owner husbands, and nearly nine-tenths with non-owner husbands, had incomes of less than $750. Only 30 percent of the families of industrial women had incomes so low.

There was a significant relationship in cash expenditures for food and occupation of wife at income levels of both $500-$749 and $750-$999 (tables b and c in Appendix). Where the wife assisted on the farm, much of the food supply was produced on the farm and only a small part purchased. The industrial woman not only purchased a larger proportion of her food, but she purchased more ready-to-eat foods, which are more expensive. A number commented on the fact that they could reduce their food expense if they had more time for preparation. "Cheap foods take a long time to cook," they said. A few of the industrially employed married women purchased lunches in town. Women in garment plants followed this practice more often, for they were farther from home. Many textile mill women went home to lunch.

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[18] These units take account of age and activity of family members and are based on the relation between the food expenditures of a moderately active adult and those of other individuals.

From the data available in this study, it is not possible to state which group was the best fed. The money value per expenditure unit of the industrial groups was greater, of the farm groups less; but much of the food supply of the farm group was farm-furnished, and farm-furnished food was given the monetary value of its selling price in the neighborhood. This price was in general lower than the price of the same foods sold in town. Farm-furnished foods are more likely to be "protective foods," such as milk, eggs, green vegetables. Some groups, as families of textile mill women and families of farm women with non-owner husbands, more often purchase food on credit, paying more for it than if they pay cash. Although it is not possible to state definitely which group was the best fed, it can be stated that some families in all groups were failing to get the important nutrients in the amounts needed for optimum nutrition, for some families had such low money values that no matter what the source of the food supply an adequate diet could not have been obtained.

Clothing and Its Care

In no group of families did expenditures for clothing and its care average as much as $100 (see table a in the Appendix). Families of industrial women spent more for clothing and its care, but their incomes were greater. At incomes of $500-$749 and $750-$999, with family type held constant, there was no significant relationship in total clothing expenditures of the family and occupation of the wife (tables b and c in the Appendix).

There was, however, a significant relationship in clothing expenditures of the wife and her occupation at an income level of $500-$749, but not at an income level of $750-$999.[19] This might be interpreted to mean that at low income levels the other members of the family economize in order that the wife might have clothing, but that such economy is not as necessary at higher income levels.

In table 9 is the average amount paid for a selected list of garments by the wives in the four groups purchasing these garments during the report year. As may be noted, there was a greater difference in the amounts paid by farm women whose husbands were owners and non-owners than in the amounts paid by women in the two industrial groups. Thus, textile mill women purchasing coats paid on an average $13.24. Garment plant women paid on an average $13.36 for their coats. Farm women with owner husbands bought coats which cost them on an average $9.70, while farm women with non-owner husbands paid only $7.40 for their coats.

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[19] The K value of wife's clothing to occupation at $500-$749 incomes was 12.6000; at $750-$999 incomes it was 6.8040.

Table 9. Average amounts paid for specified garments by married textile mill women, garment plant women, and farm women purchasing the same

Garment	97 textile mill women	69 garment plant women	Farm women: 100 husbands owners	Farm women: 247 husbands non-owners
	Dollars	Dollars	Dollars	Dollars
Coats	13.24	13.36	9.70	7.40
Coat suits	6.98	7.29	7.07	4.27
Rayon or silk dresses	3.90	3.77	3.15	2.29
Hats	1.74	1.72	1.65	1.21
Shoes	2.63	3.09	2.49	2.07
Silk or rayon hose	.85	.73	.69	.61

Those paying the largest amount for their garments also purchased the greatest number of garments. Thus, 61 percent of the garment plant women bought one or two silk or rayon dresses during the report year, while only 33 percent of the farm women with non-owner husbands bought this many. Fourteen percent of the garment plant women, but only 3 percent of the farm women with non-owner husbands, purchased coat suits during this period. Sixty-eight percent of the garment plant women bought more than three pairs of shoes during the report year; only 8 percent of the farm women with non-owner husbands bought as many. Two-thirds of the garment plant women purchased more than six pairs of silk or rayon hose during the report year; 1 percent of the farm women with non-owner husbands purchased as many. About one-half of the garment plant women and three-fourths of the farm women with non-owner husbands had not bought a hat in the past 2 years. Thirty-nine percent of the garment plant women and 74 percent of the farm women with non-owner husbands had not bought a coat in 2 years.

Although industrial women at low income levels spent more for clothing than did farm women, they were not necessarily always better dressed, for farm women did a little more home sewing than did industrial women. Three garments or more were ordinarily made a year by 59 percent of the textile mill women, 67 percent of the garment plant women, 72 percent of the farm women with non-owner husbands, and 82 percent of the farm women with owner husbands. Sewing machines were owned by 83 percent of the farm women with owner husbands, 51 percent of the farm women with non-owner husbands and two-thirds of each group of industrially-employed women. However, some women who owned machines rarely used them, while others not owning machines used machines of relatives or neighbors.

The House and its operation, and Furniture and Furnishing

There were greater differences in the cash expenditures between the four groups for the house and its operation than for food or for clothing and its care. Families of textile mill women spent for housing and household operation about 13 times more than did families of farm women with non-owner husbands, 6 times more than did families of farm women with owner husbands, and about two-thirds more than did families of garment plant women (see table a in the Appendix). Cash expenditures for these items were, in part, different because farm families did not have house rent to pay. Industrial families very often did pay house rent; families of textile mill women paid house rents more often than families of garment plant women. Farm families secured their fuel from nearby wooded areas usually without money cost; industrial families bought theirs.

Some of the difference in the cash expenditure of farm and industrial families for the house and its operation was due to the fact that farm families did without goods and services that were purchased by industrial families with more cash. As may be noted in table 10, industrial families more often had electric lights; oil or gas cook stoves; refrigerators; linoleum on their kitchen floors; and dining room, living room, or bedroom furniture suites. The situation of the family of the farm owner with respect to these conveniences or comforts was, however, considerably above that of the family of the farm non-owner. Many farm families lived in neighborhoods where electricity and ice were not available. Plumbing is not usually provided in homes for non-owners and requires money as well as initiative to secure for homes of owners. Electricity was available for all families of cotton mill women living in company houses, but some of the less well off families had their lines disconnected because electricity was more expensive than kerosene for lamps.

At income levels of both $500-$749 and $750-$999, there was a significant relation in household operation expense and the wife's employment (see tables b and c in the Appendix). Families of textile mill women spent more

Table 10. Specified household conveniences and comforts of families of textile mill women, garment plant women, and farm women by percentage having

Conveniences and comforts	Families of 97 textile mill women	Families of 69 garment plant women	Families of farm women	
			100 husbands owners	247 husbands non-owners
	Percent having	Percent having	Percent having	Percent having
Electric or acetylene lights	57.7	46.3	19.0	5.2
Oil or gas stove for cooking	6.1	21.7	......	.4
Sink with drain	10.3	13.0	......	......
Running water in house or on porch	9.2	21.7	5.6	1.6
Flush toilet	11.3	18.8	......	.4
Bath tub with drain	5.1	14.4	......	......
Linoleum or congoleum rug on kitchen floor	55.6	56.5	31.0	8.9
Ice refrigerator	52.5	46.3	37.0	16.5
Mechanical refrigerator	11.3	14.4	3.0	.4
Living room, dining room or bedroom suite	44.3	47.8	15.0	2.0

for household operation than they did for any other budgetary item except for food. Sixty-one percent of these families spent $100 or more. They more often bought fuel, had electricity, used ice, and hired household help. Forty-one percent had daily household help; only 17 percent of the families of garment plant workers had help so often. Only one family of farm women had daily household help. No expenditure for household help was made during the report year by 30 percent of the families of textile mill women, 38 percent of the families of garment plant women, and 94 percent of the families of farm women.

When there was no household help, husbands of farm women more often assisted their wives with the family laundry than did husbands of industrially employed women; no doubt, because laundry work in the farm home is a heavier task. More husbands of industrially employed women assisted their wives with the cooking and cleaning than did husbands of farm women. Industrially employed women had more assistance from relatives than did farm women. The fact that they had such assistance made gainful employment possible in some cases. Women of all four groups received about the same amount of assistance from their children in household tasks such as cleaning, cooking, and laundry work, but children of farm women more often gave assistance in milking, care of poultry, and gardening, farm families more often having these chores to be done.

Families of industrial women, because they had greater incomes, spent more for household furnishings and equipment than did families of farm women (table a in the Appendix). When income and family type were held constant, no significant relation was found in cash expenses for furniture and furnishings and employment of wife (tables b and c in the Appendix). When income increased, expenditures for furniture and furnishings increased. One of the reasons for crowding of families of farm women with non-owner husbands was low income, and consequently a limited supply of furniture.

Automobile, Other Travel and Transportation

At the time of this study about 47 percent of the families of textile mill women, 51 percent of the families of garment plant women, and 43 percent of the farm families with owner husbands and 19 percent of those with non-owner husbands, owned automobiles or trucks; somewhat more than this number had owned automobiles or trucks at some time during the report year. In other words, some of those owning cars had sold them or "let them go back." Expenditures for auto or truck for family use (use of auto or truck for farm was regarded as a farm expense) by those families having autos or trucks were for the textile mill group, $177; for the garment plant group, $190; for the farm owner group, $88; and for the farm non-owner group, $64. Some of the autos owned by farm families were of the 1927-28 vintage and were used only for an occasional visit to town or church.

Industrial families had more expensive cars and used them more, for they had greater incomes. No relation was found in auto expenses and occupation of wife when income and family type were held constant (tables b and c in the Appendix). Some women employed in industry used their autos for going to work, but this expense was generally reduced by taking others, especially where distance from work was considerable.

Expenses for other travel and transportation were incurred in the main by those not owning autos or trucks. Families of textile mill women with this expense spent an average of $14. Families of garment plant women with such expense averaged $32, while families of farm women with owner as well as with non-owner husbands averaged $10. There was no significant relation found in family expenditures for travel and transportation and the wife's occupation at income levels of $500-$749 and $750-$999.

Personal Care

It is interesting to note that a more significant relation is found between the wife's occupation and expenditures for personal care, than between the wife's occupation and expenditures for clothing and its care. This relationship between expenses for personal care and the wife's occupation is closer in low-income families. Personal care expenses include such services as haircuts and waves and such goods as dentifrices, toilet soap, cosmetics, tooth brushes, and the like.

There were only 10 families that made no expenditures for goods or services in this group, and all of these were families of farm women with non-owner husbands; many farm families, however, spent very little for these items. In almost every neighborhood there was someone who trimmed, gratis, the hair of men and boys. In some neighborhoods women with a talent for "setting hair" contributed this service to women and girls nearby. Two-thirds of the industrially employed women had beauty parlor expenses. Only one-third of the wives of farm owners and one-fifth of the wives of farm non-owners had this expense. Not only did more industrial women go to the beauty parlor, but those going spent more on an average than did the farm women having this expense. Industrially employed women usually paid $3 for a permanent wave. Farm women usually paid $2. Wives of farm owners averaged somewhat more than did wives of farm non-owners.

Cosmetics were purchased during the schedule year by all industrial women except two, by 85 percent of the farm women with owner husbands, and by 65 percent of those with non-owner husbands. Average expenditures for those with this expense were: For wives of farm owners, 88 cents; for wives of farm non-owners, 63 cents; for women in garment plants, $1.63; and for women in textile mills, $1.22.

Medical Care

Industrial families spent somewhat more for medical care than did farm families (table a in the Appendix). All families of textile mill women had expenditures for medical care since a medical fee was charged to employees in these plants, either on the basis of so much a worker or on the basis of the number in the family.

Since expenditures for medical care represent ability to pay rather than need, they do not furnish a good basis for comparing the health of members of families. Records of illnesses of members give one basis for comparing health of members of families.[20] Fifty-five percent of the families of garment plant workers, 30 percent of the families of textile mill workers, 48 percent of the families of farm women with owner husbands, and 33 percent of the families of farm women with non-owner husbands, had no sickness in bed of 3 days duration or more of a member during the schedule year.[21] Five percent of the families of textile mill women, 1 percent of the families of garment plant women, 1 percent of the families of farm women with owner husbands, and 27 percent of the families of farm women with non-owner husbands averaged two or more spells of illness of 3 days duration or more in bed per family member. Families of textile mill women and of farm women with non-owner husbands had more members with illnesses of 1 weeks duration or longer than did families of garment plant women and of farm women with owner husbands.

In brief, there was more sickness in homes of textile women and of farm women with non-owner husbands—more illnesses per member and illnesses of longer duration. The situation of the family of the farm woman with non-owner husband was somewhat worse in this respect than was the situation of the family of the textile mill woman.

Garment plant women had fewer children; and since young children are sick more frequently than are young adults, there would naturally be less sickness in such families. Families of farm women with owner husbands had better food and were better housed than families of farm women with non-owner husbands and consequently had less sickness.

Tobacco

The majority of families in all four groups had some expense for tobacco. Most of this expense was for smoking tobacco, but some bought snuff and chewing tobacco. Tobacco was not used in 26 percent of the families of garment plant women, 17 percent of the families of farm women with owner husbands, 12 percent of the families of textile mill women, and 11 percent of the families of farm women with non-owner husbands. Expenditures for tobacco per family averaged more for industrial families than for farm families. A smaller proportion of families of garment plant women than textile mill women used tobacco, but members of families of garment plant women more often used cigarettes.

Recreation

Recreational expenditures were generally for hunting licenses and hunting supplies, toys, radios and radio supplies, and movies. Cash expenditures for these varied with income. Radios were owned by 51 percent of the textile mill families, 43 percent of the garment plant families, 41 percent of the farm families with owner husbands, and 17 percent with non-owner husbands.

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[20] This comparison has the weakness, however, in that very sickly women or women with very sickly families do not ordinarily seek work away from home.

[21] Accidents and childbirth not regarded as illnesses.

The percentage of families in each of the four groups having recreation expense did not correspond with the average expense per family, for a few textile mill families spent large amounts for recreation; other textile families spent nothing. In fact, 24 percent of these families had no recreational expense during the report year. Only 13 percent of the families of farm women with owner husbands and 17 percent of the families of garment plant women, had no recreational expense during the same period. Thirty-eight percent of the families of farm women with non-owner husbands did not have this expense.

Families of farm women with owner husbands and of garment plant women participated more frequently in organizations of the community than did families of farm women with non-owner husbands and families of textile mill women. As may be noted from table 11, members of families of farm women with owner husbands and of garment plant women attended church and Sunday School more frequently. Such activities were more often enjoyed by the farm family as a unit than in the case of industrial families which were more often found living in towns where children could go alone if they desired. Most frequently attended by all four groups were Baptist, Methodist, and Holiness churches (Church of God, Penticostal, and Assembly of God). More textile mill families participated in Holiness churches than did families in the other groups. Some families in all groups limited their church activities to attendance at summer revivals; others never attended church, especially non-owner families who often had no easy way of getting to church, and often had an inadequate supply of clothing for social participation. About 40 percent of the husbands and wives in the farm non-owner families had not attended church during the schedule year. Some of the garment plant women residing in rural areas were leaders in church organiza-

Table 11. Attendance at church and Sunday School of husbands, wives, and children 6 years and over of families of textile mill, garment plant, and farm women

	Percent from families of			
Attendance once a month or more	97 textile mill women (66 with children 6 yrs. and over)	69 garment plant women (26 with children 6 yrs. and over)	100 husband owners (64 with children 6 yrs. and over)	247 husband non-owners (144 with children 6 yrs. and over)
Church				
Husband	22	45	65	17
Wife	20	45	63	17
Children 6 years and over	29	47	69	22
Sunday School				
Husband	9	30	40	15
Wife	9	32	38	15
Children 6 years and over	58	69	47	23

tions. One of these women was church organist; several others taught Sunday School classes.

The church was the social organization receiving greatest attention by members of families in all four groups, but members of farm families, especially farm owner families, participated to some extent in agricultural organizations. Husbands in a few of the industrial families were Masons. Some farm women attended WPA Adult Educational classes.

Visiting with neighbors and friends was a favorite kind of recreation in all four groups. Textile mill families, for the most part, limited their visiting to families of the same occupation. Most of the industrial families went to town on Saturday afternoon to pay for goods already secured or to make selections. The children in some of these families attended the movies. Sometimes on Saturday night the entire family attended. Farm families rarely attended the movies.

Reading and Education

No significant relationship was found between the wife's occupation and money spent for reading matter and education. Industrial families spent more for reading matter than they did for education; farm families spent more for education than for reading matter. This was because farm families had more children in school. Industrial families (especially textile mill families) more often took a daily paper; comparatively few farm families did so. Some of the textile mill families purchased light fiction magazines quite regularly. Relatively as many farm families with owner husbands as textile mill families had expenses for reading matter, but the average expenditure was less for the former than for the latter. Reading material of farm families consisted for the most part of farm papers and magazines.

The groups with the greatest number of children were the groups spending least for education. Thus, families of garment plant women with children in school spent an average of $16 for education; those of textile mill women spent $10; those of farm women with owner husbands spent $9; and those of farm women with non-owner husbands spent $7. Some of the low-income farm families with a number of children in school did not purchase all the supplies needed by their children. In fact, in several cases the children had to quit school because the "family could not buy the supplies."

Gifts, Community Welfare, and Taxes[22]

These expenses included, for the most part, contributions to the support of, or gifts to, persons outside the economic family, contributions to church, and poll taxes. In the industrial plants where the women of this study were employed, purses were quite frequently made up for "hard luck" individuals in their group—individuals who had suffered from losses due to death, sickness, or fire. "Passing the hat around" was quite common in these plants.

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[22] Only personal income taxes, poll taxes, and certain personal property taxes are included here. Other taxes, such as excise and sales taxes, are merged with goods and services to which they apply. Taxes on business-operating and income-producing property were deducted in estimating net income.

Showers were often given (especially in the garment plants) for the women who were to get married or had new babies. In fact, contributions and gifts to associates in the plant were for many the only expenditures of this kind.

The average amount spent for these items by the four groups of families concerned is important, but the number in each group having such expenses must also be noted. The fact that more than half (53 percent) of the families of farm non-owners had no expense for these items is significant. Only 6 percent of the families of farm owners failed to make such expenditures. Farm owners usually made some contribution to the church. The rural church of course, depends in the main on this group for support.

Very few women in this study voted. More wives of farm owners than any other group voted, for they were especially interested in the election of a supervisor for their beat. It was the beat supervisor who could obtain for their family or their neighborhood certain advantages. Many women thought they could use the $2 required for poll taxes to better advantage. The husband did not vote in many cases, though in all groups more husbands than wives voted.

Family Consumption and the Occupation of the Wife

When income and family type were the same, many of the differences in family consumption could be explained as differences in composition of income. Families of farm women spent less cash for food, fuel, and housing, because more of these were furnished by the farm than in the case of families of industrial women.

There were, however, other relationships found in occupation of wife and consumption, especially at lower income levels. At lower income levels, industrial women spent more on clothing and personal care items than did farm women. Farm women at low income levels spent the minimum for clothing and personal care. They did their own housework and rarely purchased ready prepared foods. Many made no expenditures for transportation. Indeed, the savings resulting from such practices were sometimes as much as were the earnings of the women in industrial work, but so low were the incomes of some of the husbands of women in industrial work that even a small amount cleared seemed a "godsend."

Net Surpluses and Deficits

Seventy percent of the families of garment plant women and 60 percent of the families of farm women with owner husbands had net surpluses, that is, money income exceeded current expenditures (table 12). These surpluses amounted to an average of $93 for garment plant families and $164 for farm families with owner husbands. About one-half of the families of textile mill women and of farm women with non-owner husbands spent more than their money income and incurred net deficits averaging $70 and $59 per family.

Taken as a whole, families of textile mill women and families of farm women with non-owner husbands each showed a net deficit (table 12). These deficits amounted to 0.5 percent of the money income of the former group and 3.6 percent of the money income of the latter group.

For the entire group of garment plant families and farm-owner families there was an average net surplus (table 12). These surpluses amounted to 10.1 percent of the money income of families of garment plant women and 20.7 percent of the money income of the families of farm women with owner husbands.

Table 12. Net change in assets and liabilities of families of textile mill, garment plant, and farm women, 1938-39

Item	Families of 97 textile mill women	Families of 69 garment plant women	Families of farm women	
			100 husbands owners	247 husbands non-owners
Average net money income	$ 864	$ 752	$ 363	$ 197
Average net money expenses	873	681	309	214
Surplus**				
Percent of families	49	70	60	41
Average amount	$ 140	$ 93	$ 164	$ 53
Deficit**				
Percent of families	51	30	34	49
Average amount	$ 70	$ 95	$ 68	$ 59
No change in net worth**				
Percent of families	------	------	6	10
Average annual change in net worth**				
Amount***	$ –4	$+76	$+75	$ –7
Percent of income	–.5	+10.1	+20.7	–3.6
Change in crops stored and livestock owned	*	$ +8	$+32	$ +7
Change in net worth (money and non-money items included)****	$ –4	$+84	$+107	------

*Less than 50 cents.

**Changes resulting from actual money transactions.

***Negative amounts indicate a net deficit; positive amounts a net surplus; average net change in assets and liabilities do not equal the exact difference between money income and money expense. In accepting a schedule an error of 5 percent of the income or expenditure, whichever was greater, was permitted in case of non-farm families; an error of 10 percent in the case of farm families was allowed.

****Does not represent a complete statement of net worth, but only change in net worth during report year.

Disposition of Money Received But Not Used For Current Family Expenditures

The most frequent method of providing for the future was for all four groups insurance and savings (table 13). All industrial families had social security insurance deducted from their wages and consequently all of these families had funds in this form. The form of insurance ranking next in importance was burial insurance, which provided a funeral in case of death of family member. This type of insurance was carried by many farm families as well as by many industrial families. Several plants provided for those who desired it a group insurance which paid a set sum in case of death. Insurance providing cash in case of death was carried by one or more members in 35 percent of the families of textile women, 60 percent of the families of garment plant women, 7 percent of the families of farm women with owner husbands, and 1 percent of the families of farm women with non-owner husbands.

Table 13. Disposition of money received during the schedule year but not used for current family expenditures by families of textile mill, garment plant, and farm women

Funds made available	Families of 97 textile mill women		Families of 69 garment plant women		Families of farm women 100 husbands owners		Families of farm women 247 husbands non-owners	
	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having
		Dollars		Dollars		Dollars		Dollars
Investment in land or home	14	137	26	180	30	184	3	131
Improvement in home	2	35	3	550	1	17	----	----
Investment farm business other than land	6	83	9	52	26	161	20	93
Repayment other back debts	32	54	25	46	17	101	18	43
Insurance and savings	100	28	100	45	69	33	52	13
All other	3	17	3	49	6	87	2	136

Savings accounts were most often had by families of garment plant women and of farm women with owner husbands. Families of garment plant women had savings more frequently, however, than did families of farm women with owner husbands. One family in every six in the garment plant group had a savings account. These families were generally saving for some purpose—to buy land, a home, furniture, an automobile. Few textile mill families saved. According to a minister who had worked with these people for many years, and who had himself been a textile worker, "Textile workers do not have the philosophy of saving." There were, though, a few textile mill families with savings accounts.

Thirty percent of the families of farm women with owner husbands and 26 percent of the families of garment plant women made payments on land or a home during the report year. Twenty-six percent of the farm owner families invested in farm business other than land. Fewer families of textile women and farm women with non-owner husbands thus disposed of money received.

Funds Available for Family Use From Sources Other Than Family Income

Some of the reasons why families incurred deficits during the report year are shown in table 14. Many of the deficits in the textile and farm non-owner groups were due to failure to meet all family living expenses. Many textile mill families got in debt when the mills were running short time. Many non-owner farm families got in debt before the sale of crops in the fall. For both it was the case of a limited demand and a low price for their products. Both groups were victims to some extent of a social system over which they had no control. To tide over weeks and months when little cash income was received, they bought on credit at higher prices. Garment plant families managed better through slack work; the husband as a rule was in another occupation, quite frequently farming. These families were smaller than textile mill families. Farm-owner families managed better than non-owner families, for if there was non-farm work available in the community they were more likely to get it. Farm-owner families were more likely to have several cash crops; this variety of crops brought in money throughout the year.

Table 14. Classification of funds of families of textile mill women, garment plant women, and farm women made available for family use from sources other than family income

Funds made available	Families of 97 textile mill women		Families of 69 garment plant women		Families of farm women: 100 husbands owners		Families of farm women: 247 husbands non-owners	
	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having	Percent having	Av. amt. for those having
		Dollars		Dollars		Dollars		Dollars
Reduction in savings	4	168	9	91	11	150	2	21
Sale of assets to raise cash	3	12	1	300	7	84	5	98
Increase in amounts due installment for furniture	33	41	16	39	5	30	4	27
Increase in amounts due installment for automobile	10	112	13	125	4	79	5	69
Increase in amounts due all other installments	10	62	3	55	3	50	2	45
Increase in other debts for family living	47	74	13	46	18	31	38	41
Increase in debts for farming	1	29	1	156	12	142	12	55
All other	4	62	4	128	11	123	13	89

It is interesting to note in each group the proportion of families which bought on installment. Farm families differed quite a bit from industrial families in this respect, industrial families using this method of purchase much more frequently than did farm families. Widespread use of this method of purchase by farm people is dependent on the development of regular sources of income throughout the year, as well as on better roads, cheaper means of transportation, and a general change in the philosophy of farm people. At present there are numbers of farm families who believe cash should be paid for goods when purchased.

Since garment plant families and farm owners save more, they more often have savings to fall back on in case of emergency. This explains the greater proportion with a reduction in savings in these two groups. Table 14 points to the need for some method of financing family living expenses for low income groups.

Levels of Living Compared

At the beginning of this report, the problem was stated to be that of determining whether industrial employment or the farm provided better living for farm-reared women. It has been shown thus far that married, housekeeping farm women and their families had less income per family member than did married housekeeping industrial women and their families.

From this it would seem that families of garment plant and textile mill women were "better off" than families of farm women with owner and non-owner husbands. Yet tables 7, 11, and 12 tell us that families of garment plant women and of farm women with owner husbands lived in less crowded quarters, participated more in church activities, and saved more than did families of textile mill women and of farm women with non-owner husbands. Their family members had fewer illnesses than did the family members of the other two groups.

It would thus seem that income is not the only factor in levels of living. Where industrial employment and better living occur together, there seem to have been more advantageous socio-economic factors previous to the employment.[23/] The garment plants attracted women reared in families of higher socio-economic status, women with more schooling, women who were more likely to marry farmers, than did the textile mills. The owner-farm drew women from families of higher socio-economic status, women with more schooling than did the non-owner farm.[24/]

SOME CONTRASTS IN LEVELS OF LIVING OF SINGLE WOMEN ENGAGED IN FARM, TEXTILE MILL, AND GARMENT PLANT WORK

As previously indicated (table 3), there were 143 single factory women and 151 single farm women eligible for this study. Thirty-seven of these factory women worked in textile mills and 106 in garment plants. Eighty-

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[23/] For a discussion of why garment plants drew a different type of labor supply, see "Some Contrasts in Women Employed in Two Types of Industries in Mississippi," Dorothy Dickins, Social Forces, Vol. 19, No. 4, May 1941, pp. 522-532.

[24/] Fifty-one percent of the farm women with non-owner husbands, 49 percent of the textile mill women, 81 percent of the farm women with owner husbands, and 71 percent of the garment plant women were reared in homes of farm owners and the remainder in homes of farm non-owners. Five percent of the farm women with non-owner husbands, 2 percent of the textile women, 38 percent of the garment plant women, and 19 percent of the farm women with owner husbands had had high school education or more.

six of the farm women were daughters of landowners; 65 were daughters of non-owners.

There were perhaps several reasons why more single girls worked in garment plants than in textile mills. Textile mill women married earlier.[25] In addition, few new workers were being employed by textile mills at the time of this study, for orders were down and "spare hands" were available at all the mills.

Since landowners are older men, they have more children of 17 to 35 years. This explains in part why more of the women of this study were landowners' daughters and why more of the single farm women were landowners' daughters. Another explanation for the larger number of single daughters of landowners was that they did not marry as young as did daughters of non-owners.

Incomes

Since the single farm woman received her income largely in the form of goods and services, and the factory woman received hers in the form of cash, it is difficult to compare the incomes of the two groups. The farm woman assisted her family in the production of one or more farm products offered for sale. She had not had gainful nonfarm work more than 149 days during the report year.

About one-third of the single farm women who were daughters of owners and about one-half who were daughters of non-owners, earned during the report year; the remainder depended entirely upon their families for the goods and services needed (table 15). The cash earnings of young women

Table 15. Method of earning of single farm women, 17 to 35 years of age

Method of earning*	Daughters of Farm owners Total number 86: Number earning	Daughters of Farm owners Total number 86: Average amount earned by those earning	Daughters of Farm non-owners Total number 65: Number earning	Daughters of Farm non-owners Total number 65: Average amount earned by those earning
		Dollars		Dollars
Farm wage work	9	9.64	23	6.73
Sale of farm products	9	39.90	4	14.75
Domestic service	3	27.33	3	8.38
Other unskilled and semi-skilled work	1	30.00	1	28.00
Clerical work	2	66.00	0	......
NYA or WPA	6	29.18	1	26.00
Sale of handicraft	0	......	1	8.00
Total	27	32.03	30	10.04

*Some had more than one method of earning.

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[25] Two-thirds of the women in the three textile mills who had married, married the first time before they were 20 years of age, while only one-half of the women in the two garment plants married so early. See page 526, "Some Contrasts in Women Employed in Two Types of Industries in Mississippi," Dorothy Dickins, Social Forces, Vol. 19, No. 4, May 1941.

whose family heads were farm owners averaged about $10; the earnings of those whose family heads were farm non-owners averaged $5. Thus, fewer daughters of owners earned, but those who did, earned more.

Single textile mill women earned on an average, $401; single garment plant women earned $423. This was slightly more than was earned by the married, housekeeping women in these plants.

Farm owner families contributed to their farm daughters in the form of clothing, waves, cosmetics, medical care and spending money, an average of $23; farm non-owner families contributed $14 to their farming daughters. These amounts added to the $10 and $5 earned gave single farm girls the equivalent of $33 and $19 cash, respectively. Such amounts were much below the amounts earned by factory, single women. Factory, single women, however, paid about $173 a year for lodging and meals, and when this fact is taken into consideration, the differences in the amounts the young women actually had to spend were not as great as they would seem.

Lodging and Meals

Textile mill women spent on an average $218 for lodging and meals; garment plant women spent $157. Expenditures for lodging and meals included the amount which women rooming and boarding paid during the report year, or the amount which housekeeping women spent for food, housing, and household operation. For those living at home, the amount paid the family in cash or goods was regarded as expenditures for lodging and meals. It was rather difficult to secure facts pertaining to the amounts contributed by women living with families or relatives when the contribution was in the form of foods, fertilizer, clothing, or payments on auto or mule.

All farm women and the majority of factory women lived at home. (See table 16 for housekeeping arrangements of factory women.) Less than 5 percent of the young women living at home failed to contribute to the family. One-fourth of the textile mill girls and one-tenth of the garment plant girls at home paid a set sum each pay roll period to their families. The fact that more of the textile mill group lived in town—where food, fuel, and housing had continually to be purchased for cash, where there were many roomers and boarders, where industrial work was not a new thing—probably accounts for the difference in the proportion of girls with the status of roomer and boarder at home.

The most common arrangement was for single girls in both groups living at home to pay part on the family expenses; that is, to purchase all or part of the groceries, the family clothing, or make payments on the family car. This lack of definite financial arrangements with their families was no doubt because the parental families of these young women were farming or had farmed in the past. In such homes it is not customary to accept money for room and board from adult children.

About one-third of the garment plant, single girls and one-fifth of the textile mill, single girls did not live with family or relatives (table 16). Fewer of the single girls in garment plants lived at home than did textile mill

Table 16. Housekeeping arrangements of single textile mill and garment plant women

Housekeeping arrangement	Single girls in			
	Textile mills		Garment plants	
	Number	Percent	Number	Percent
Do light housekeeping	1	2.7	22	20.8
Room and board with unrelated persons	6	16.2	16	15.0
Live with parental family or other relatives	30	81.1	68	64.2
1. Pay part family expenses	14	46.7	54	79.4
2. Pay all family expenses	2	6.7	4	5.9
3. Room and board*	8	26.7	7	10.3
4. Turn over check	5	16.7	0	------
5. No contribution	1	3.2	3	4.4
Total	37	100.0	106	100.0

*Defined as paying a set sum each pay roll period.

girls, because more of the fathers of these garment plant girls were farming at the time of the study. Many garment plant girls were, therefore, too far away from home to commute daily to work.

A number of these garment plant girls not living at home did light housekeeping (table 16), securing some of their food from home. The 22 light housekeeping, garment plant women had nine different types of living arrangements. The most common was for three girls to sleep, cook, eat, and live in one room. Ten of the 22 housekeeping girls, however, had as much as one room per person.

The question is often asked how housekeeping arrangements affect what the daughter gives her family and it is answered at least in part in table 17. Here expenditures are shown for three groups in the same industry: those rooming and boarding with unrelated persons in town, those doing light housekeeping in town, and those in the country living with their families. There were too few living in town with related persons or living in the country with unrelated persons to include in this table.

Table 17. Specified expenditures by single garment plant girls rooming and boarding in town with unrelated persons; doing light housekeeping in town; and living in in the country with their parental families

Expenditures	Housekeeping arrangements of single women in garment plants		
	15 rooming and boarding in town with unrelated persons	22 doing light housekeeping in town	58 living in the country with parental family
	Dollars	Dollars	Dollars
Lodging and meals	180	145	148
Drinks and lunches	8	15	13
Travel or auto	15	22	50
Gifts to family	10	44	0
Total	213	226	211
Income	390	467	400

As may be noted from table 17, the girls living at home contributed about $12 a month. Those doing light housekeeping in town contributed about $4, and those rooming and boarding in town about $1 a month. In other words, the parental family profited most when the daughter resided with them. The expense incurred of having one extra in a home, especially in a rural home where much of the food is home-produced, is very little. The transportation expense of the daughter living at home was much greater, but her living expenses were no more than those of the girls living in town. Those girls in town spent many of their week ends at home (some of them spent all of the week ends at home) and this too meant expenses for transportation.

About two-thirds of the factory women living at home paid as much or more than the going rate of board.[26] Somewhat more of the garment plant group paid this amount than did the textile mill group, but more of the garment plant women resided in the country where the going rate of board was less.

Single factory women residing at home contributed to family expenses, and in turn received certain goods and services. Single farm women residing at home assisted in farm and household work, and in turn received certain goods and services. Did single factory women receive better housing and better food than did single farm women?

Single garment plant girls were perhaps the best housed group. They more often resided in homes with modern lighting, heating, and plumbing facilities; they had a room to themselves or roomed with only one other more frequently than did the girls in the other three groups (tables 18 and 19). Most poorly housed were the farm girls whose family heads were non-owners. They lived in the country where household conveniences were not generally available. Non-owner farm families with adult children are usually large families with low incomes, and this usually means room crowding.

Table 18. Percentage distribution of single textile mill, garment plant, and farm women according to the number of persons with whom they roomed

Number of persons with whom roomed	37 textile mill women	106 garment plant women	Farm women: 86 family head owner	Farm women: 65 family head non-owner
	Percent	Percent	Percent	Percent
0	24.3	21.7	22.1	13.8
1	40.5	49.1	42.9	38.5
2	27.1	28.3	26.7	26.2
3	2.7	.9	8.1	21.5
4	2.7	------	1.2	------
5	2.7	------	------	------
Total	100.0	100.0	100.0	100.0

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[26] The going rate of board corresponded as closely as possible to the average amount charged in the community for the type of board secured by those of similar socio-economic status.

Table 19. **Household conveniences furnished by families with whom single girls resided**

Household conveniences	37 textile mill women	106 garment plant women	Farm women 86 family head owner	Farm women 65 family head non-owner
	Percent having	Percent having	Percent having	Percent having
Electric lights	51.3	61.3	5.8	1.5
Bathtub with drain	13.5	30.2	------	------
Flush toilet	24.3	30.2	------	------
Method of heating:				
Fireplace	94.6	79.2	97.7	100.0
Stoves	5.4	1.9	2.3	------
Gas	------	18.9	------	------

No data are available concerning food consumption of girls in the four groups, but it is thought that the textile mill girls were perhaps not as well fed as the garment plant girls. Fewer textile mill women lived in farm homes, where a large proportion of the food served is home-produced, and such food is usually rich in minerals and vitamins. The mothers of some of the textile mill women worked at the mill, and this often meant that little attention was given to selection and preparation of the food for the family. Another indication that the textile mill group may have been more poorly fed is the fact that they had more illnesses during the schedule year than did the garment plant group. Thirty percent had one or more spells of illness of 3 days or more, while only 15 percent of the garment plant women had been ill as much. The former averaged 0.6 spell of illness per person in bed, while the latter averaged 0.2 spell of illness per person.

Farm girls who were daughters of owners should have been better fed than were farm girls who were daughters of non-owners, because owners produce more food on the farm and have larger cash incomes. Daughters of owners averaged 0.2 spell of illness in bed (as did garment workers); daughters of non-owners averaged 0.4 spell during the report year. Differences in illnesses of girls in the two groups were not due entirely to differences in food, though food no doubt played a part.

Other Goods and Services

Since farm women lived at home as members of the family, it is not possible to state what their meals and lodging cost. It is possible, however, to state the amount spent for clothing, personal care, recreation, and other goods and services of these young women. As may be noted from table 20, very little was spent.

Clothing and Personal Care

Single, garment plant girls spent more for clothing than did textile mill girls (table 20). These girls had somewhat higher incomes and clothing standards were higher in garment plants. Garment plant girls dressed up more for work than did textile mill girls. Formerly there was much lint in cotton mills and the women had little incentive to go to work well-dressed. This condition has been improved in the last few years.

Table 20. **Average cash expenditures for goods and services other than meals and lodging by single women**

Expenditures	106 garment plant women	37 textile mill women	Farm women 86 family head owner	 65 family head non-owner
	Dollars	Dollars	Dollars	Dollars
Clothing	77	54	24	15
Personal care	10	9	3	2
Recreation	10	10	3	2
All other	133	99	3	*
Total	230	172	33	19

*Less than 50 cents.

Garment plant women paid more for most articles of clothing (table 21) and purchased more expensive garments than did textile mill girls. Single, farm girls whose family heads were farm non-owners paid least of all for garments purchased, and purchased fewer garments.

Table 21. **Average amount paid for specified garments by single garment plant, textile mill, and farm women**

Garment	106 garment plant women	37 textile mill women	Farm women 86 family head owner	 65 family head non-owner
	Dollars	Dollars	Dollars	Dollars
Coat	16.60	14.28	9.84	7.48
Coat suit	7.66	7.14	6.28	5.35
Rayon or silk dress	4.31	4.39	2.81	2.39
Hat	1.94	1.09	1.60	1.37
Shoes	3.46	3.66	2.38	2.06
Silk or rayon hose	.83	.79	.67	.65

During the report year garment plant girls bought 10 to 12 pairs of shoes, textile mill girls 7 to 9 pairs, and farm girls both from homes of owners and non-owners from 4 to 6 pairs. About two-thirds of the industrially employed girls, three-fifths of the farm girls with owner fathers, and one-half with non-owner fathers purchased one or more coats during the report year. One textile mill girl and 26 farm girls (19 daughters of non-owners) did not purchase silk or rayon hose during the schedule year; these girls wore socks instead. Fewer garment plant girls wore socks than did girls in the other three groups. A number of textile mill girls wore socks to work (textile mill girls were younger than garment plant girls). One-tenth of the garment plant girls, one-fifth of the textile mill girls and farm girls with farm-owner family head and one-half of the farm girls with non-owner family head did not buy a rayon or silk dress during the report year. Only four hats were purchased by daughters of farm non-owners during this period.

Even allowing for differences in need and in amount of home sewing[27] many of the farm girls were poorly dressed as compared with the industrial girls. Desire for better clothing was often the incentive that led the farm girls to seek work in industry. When the cotton crop was short and farm expenses were paid, there was nothing left for a coat or new dress. The one way to get these would be to get a job.

Differences in expenditures for personal care items by the four groups were as great as were differences in expenditures for clothing. More was spent for permanent waves than for other personal care items. The majority of girls in all the four occupational groups purchased permanent waves during the report year, but expenses for waves were three times more for textile mill girls and two times more for garment plant girls than for farm girls. Farm girls from owner homes spent about the same for waves as did farm girls from farm non-owner homes, but more girls from owner homes purchased waves. Permanent waves were regarded as more essential than hats. In fact, they took the place of hats, for "If you have a wave, you don't need a hat."

Recreation

Recreational expenditures included expenditures for such items as radios and supplies, tickets to movies, club dues, and the like. Industrial girls living in town attended the movies once or twice a week, usually with an escort. They spent much of their leisure time riding around or visiting with friends. Some attended dances though not frequently. There was little dancing in the homes.

Of the different groups, farm girls who were daughters of owners attended church most often; textile mill girls least often. Much of the social life of the farm girl, especially the daughter of the owner, was centered around the church, the league, and singings. The industrial girl living in town attended church less often than did any other group. "I just don't feel at home," she said. Many of these girls never attended church except when they visited home. Industrially employed girls living in rural areas participated in organizations of the community as frequently as did farm girls.

One of the garment plants had a recreational center which was used in the main by the younger single women of the plant. There were held dances, showers, bridge parties and club meetings. A clerk in this plant had also organized a basket ball team, and the girls practiced in the afternoons after work during certain seasons of the year. The other plants provided no recreational facilities, but such facilities were needed especially in the industrial plants located in villages where there were no means of wholesome recreation for the younger group. In one of these plants the young people collected at a "beer joint."

All Other

As may be noted from table 20, expenditures for "all other" (that is, expenses for auto, other travel and transportation, furniture, household equipment, medical care, gifts, and the like)[28] were many times greater for the industrial girls than for the farm girls. Garment plant girls spent on an average $60 for auto and other travel and transportation. Twenty-three of the 106 single garment plant girls owned autos; none of the textile mill or farm girls owned them.

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[27] About 45 percent of the garment plant girls, 70 percent of the textile mill girls, and 40 percent of the farm girls, did no home sewing.

Textile mill girls averaged, during the report year, $29 for furniture and household equipment; garment plant girls averaged $18. One of the first items purchased by some of the single girls after they began work at the plant or mill was a bedroom suite, which was bought on installment and for which about $65 was paid. Fifteen of the textile mill women and 26 of the garment plant women owned bedroom or living room suites. Five of the industrially employed girls were purchasing electric refrigerators and washing machines at the time of the study, these as a rule to be used by the parental family until the young women established homes of their own. Furniture and equipment purchased before marriage would serve as a basis on which to begin housekeeping in homes of their own.

All textile mill women had medical care expense because of the medical insurance in operation in all the textile mills; only 40 percent of the garment plant women had such expense. This expense was more often for dental services than for the service of a physician. Farm girls had little expense for medical care. Several of them, however, spoke of needing medical attention.

As has been previously pointed out, the majority of single, industrial women lived with their parental families; only 45 of the 141 women thus employed did not. Thirty-nine of those not living with families made contributions to their parental families, either in the form of money or gifts. Contributions of industrial women living at home have been discussed.

Farm girls who earned also contributed to their parental families. The daughters of non-owners contributed relatively more than the daughters of owners, though absolutely somewhat less. About one-fourth of the farm single women who earned contributed to their families. More than 90 percent of the industrial women who earned contributed to their families. The cash earnings of farm women were sufficient in most cases to purchase only a few much needed goods and services.

Net Surpluses and Deficits

Since farm girls had no regular cash income they could not make savings or incur debts. Industrial girls, however, could. The majority of girls in both of these groups had increases in net worth during the schedule year. Ninety percent of the garment plant girls and 70 percent of the textile mill girls increased in net worth during this period. Fifty-three of the 106 single, garment plant women and seven of the textile mill women carried life insurance. A number in each group carried burial insurance, though this was not as common as in the case of married, industrial women. One textile mill girl was buying land; 2 garment plant girls were buying houses; 44 garment plant girls and 4 textile mill girls had savings accounts.

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[28] One-fourth of the industrial girls had expenditures for reading matter; no farm girls reported such an expenditure, though some were from families having this expense. Some of the girls purchased tobacco. Smoking was more prevalent among industrial town girls than among farm girls or industrial girls residing in the country.

Single girls did not go in debt to meet ordinary living expenses as frequently as did married girls. Most of those showing a deficit during the report year had increased installment notes due. Eight garment plant workers were buying autos. Several in both groups were buying furniture. Three textile mill girls and two garment plant girls were buying radios on installments.

Table 22. **Average cash income,* expenditures,* and net surplus of single garment plant, textile mill, and farm women**

Item	106 garment plant women	37 textile mill women	Farm women 86 family head owner	Farm women 65 family head non-owner
	Dollars	Dollars	Dollars	Dollars
Income	423	401	33	19
Expenditure	387	390	33	19
Net surplus	36	11	------	------

*Includes cash earnings and amount of cash spent for goods and services by parental family for farm girl.

Levels of Living Compared

Single, industrial women had more cash to spend than single, farm women, but their situation as compared with farm women was not always better. Thus, sickness per member was higher in the textile mill group; community participation less. The situation of the garment plant women, who had had the better education and who were reared in families of somewhat higher socio-economic status than were the textile mill women, compared quite favorably with that of the farm girl with family head an owner and was much better than that of the farm girl whose family head was a non-owner.

Differences between levels of living of single women in these industries were coincident with differences in types of women and differences in residence. Many garment plant girls lived on the farm; many textile mill girls in the mill village. Residence on the farm for the industrial girl seemed good, not only for the girl, but also for her family who received generous amounts in cash and kind from these working daughters—more than was received when the daughters lived in town.

On the whole, the levels of living of the single, farm non-owners' daughters were the worst of the lot. Housing conditions were poor; overcrowding was common; and household conveniences and comforts were generally lacking. Goods and services needed by these young women were provided most meagerly by their families. In this under-privileged, little-schooled class is a large potential labor supply, but a supply that needs more training before it will be employed.[29]

SUMMARY AND CONCLUSIONS

Included in this study were two groups of farm-reared women of 17 to 35 years of age: (1) The industrial group—all those who had worked at least 12 months out of the past 2 years in one of the three textile mills or two garment plants selected; (2) the farm group—all those who during the past year had resided in the home of a farm operator located in a random sample of rural areas within a 10-mile radius of these five plants, provided that they (the women) had assisted in producing one or more farm products for sale. Those who had been students during the past year or who had had gainful nonfarm work occupying more than 149 days were not eligible for the farm group.

The incomes of the married industrial women and their families were higher than the incomes of the married farm women and their families, but the greatest differences between the incomes of these groups were not in amount of income but in the composition of income. When income and family type were the same, many of the differences in family consumption could be explained as differences in composition of income. Families of farm women spent less cash for food, fuel, and housing because more of these were furnished by the farm than in the case of families of industrial women. There were, however, other relationships found between occupation of these wives and consumption, especially at lower income levels. At lower income levels, industrial women spent more on clothing and personal care items than did farm women.

Garment plant women and their families were more similar to farm women with owner husbands and their families in respects other than income and consumption, than they were similar to textile mill women and their families. Families of garment plant women and of farm women with owner husbands lived in less crowded quarters, participated more in social organizations of the community, and saved more than did families of textile mill women and families of farm women with non-owner husbands. The former also had fewer illnesses per member.

The incomes of single, factory women were larger than those of single, farm women; but the situation of single, factory women, as compared with single, farm women, was not always better. Single, garment plant women were similar to single, farm women with owner family heads in respects other than income. Single, textile mill women more nearly resembled single, farm women with non-owner family heads.

It is not surprising that garment plant women and their families more nearly resembled farm women with owner family heads than they did textile mill women and their families. The majority of garment plant women lived in the open country, many in homes of farm owner husbands and fathers. Only one-fifth of the married textile mill women and one-sixth of the single, textile mill women lived in the open country. Only a small proportion of the husbands of married women or fathers of the single women were farming at the time of the study.

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[29] See "Some Contrasts in White Women Employees in Garment Plants Located in Three Types of Communities of Mississippi," Dorothy Dickins, Rural Sociology, Vol. 5, No. 4, Dec. 1940, pp. 427-37.

The textile mill and farm non-owner group represented a bad situation in industry as well as farming: failure to meet family living expenses. To tide over weeks and months when little cash income was received, they bought on credit at higher prices. Families of garment plant women managed better through slack work, for their heads were not, as a rule, garment plant workers. Families of the garment plant women were smaller. Farm owner families got along better than non-owner families because more of them obtained extra non-farm work available in the community. A larger part of the owner group had several cash crops which brought in money all during the year.

It would seem that industrial employment of farm-reared women does not always provide a better living than the farm would. There are varied levels of living both in industrial and farm groups. It may be that the garment plants attract farm women of higher socio-economic status who naturally prefer to live in the open country with their families or, if in town, in a location not adjacent to the plant. People with less ability or less opportunity may fill the positions as workers in the textile mills and as tenants on farms. The conditions surrounding these two types of occupation may aggravate rather than alleviate the conditions which may make them undesirable.

The textile mills with their history of mill villages, limited living space, large families, and most families entirely dependent upon the mill, have not been conducive to improved levels of living. Garment plants were established later under a different industrial order and with different labor needs. Fortunately for Mississippi, industrialization has not proceeded too rapidly. Plans can be made for rural industrial communities, combining the values of increased income and farm living. Good transportation facilities can be provided. Educational programs can be initiated for rural women most needing employment.

APPENDIX

Table a. Average cash expenditures for specified goods and services of families of textile mill, garment plant, and farm women, 1938-39

Goods and services	Families of		Farm women's families	
	97 textile mill women—average size 4.3 persons	69 garment plant women—average size 2.9 persons	100 husbands owner—average size 4.6 persons	247 husbands non-owner—average size 4.6 persons
	Dollars	Dollars	Dollars	Dollars
Food	331*	222*	83*	80*
At home	319*	195*	81*	77*
Away from home	12	27	2	3
Clothing and care	85*	91*	64*	43
Housing	57	42	7	2
Household operation	126*	61*	21*	11*
Furnishings and equipment	37	39	16	7
Automobile 1/	91	97	37	13
Other travel and transportation	6	19	4	5
Personal care	15*	14*	8*	4
Medical care	34*	29	23	24
Recreation 2/	17	14	11	6
Tobacco	17	16	12	10
Reading	5	3	2	1
Education	7	6	6	4
Gifts, community welfare and taxes 3/	13	16	12	3
Other items	32	12	3	1
Totals	873	681	309	214

*All families in group had this expenditure.

1/Net cost of automobile purchased and expense of maintenance and operation of automobile after deducting proportion chargeable to business.

2/Paid admission; equipment, supplies, fees and licenses for games and sports; radios; musical instruments; toys; pets; social dues.

3/Only poll, income and personal property taxes included here. Taxes on consumer goods included as expense for item on which the tax was levied.

Table b. Significance of wife's occupation to consumption (Family types I, II, III, V, VI1/ $500-$749)

Item	K 2/
Food value	7.08
Food expense	13.08**
Housing value	6.12
Housing expense	9.78*
Household operation value	9.96*
Household operation expense	11.88**
Clothing	7.32
Furnishings and equipment	1.56
Auto	.90
Other transportation	3.48
Personal care	12.60**
Medical care	4.20
Recreation	2.70
Tobacco	4.92
Reading	7.68
Education	1.86
Gifts and selected taxes	2.04
Cash expense family living	13.86**
Value family living	9.18*

1/See National Resources Committee "Consumer Expenditures in the United States," page 124, for a description of family types.

2/The following formula was used in getting K:

$$X_r^2 = \frac{p-1}{p\sigma^2}\sum_{j=1}^{p}(\bar{r}_j - p)^2$$

See page 678, Journal of American Statistical Association, Vol. 32, 1937, "The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance," Milton Friedman.

7.815 = value of K that may be expected due to chance variation alone once out of 20 trials. 11.341 = value of K that may occur due to chance alone once out of 100 trials. If value obtained for K lies between 7.815 and 11.341 the result is significant and is designated by *. If value obtained for K is larger than 11.341 the result is highly significant and is designated by **.

Table c. Significance of wife's occupation to consumption (Family types[1] II, III, and VI, $750-$999)

Item	K [2]
Food value	7.16
Food expense	9.00*
Housing value	3.20
Housing expense	7.16
Household operation value	4.27
Household operation expense	8.24*
Clothing	1.75
Furnishings and equipment	3.54
Auto	2.12
Other transportation	1.80
Personal care	7.22
Medical care	2.12
Recreation	4.27
Tobacco	3.26
Reading	3.89
Education	3.89
Gifts and selected taxes	4.27
Cash expense family living	10.17*
Value family living	7.02

[1] See footnote 1, table b in Appendix.

[2] See footnote 2, table b in Appendix.

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Improving Levels of Living of Tenant Families

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Home Economics Department

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
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State College, - - - Mississippi

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Improving Levels of Living of Tenant Families

By DOROTHY DICKINS, Head, Home Economics Department

There has been much talk of low levels of living among tenant families and of need for improvement. In the statement prepared for the President by the National Emergency Council on economic conditions of the South, a portion of the report is devoted to a discussion of land ownership. Low economic status of tenants was cited as one of the problems of the area.

According to the 1940 Census of Agriculture, about two-thirds of the farm operators of Mississippi are tenants. Although the proportion of tenancy for 1940 is somewhat less than at any census period since 1920, it is still relatively high; nor does there seem to be any likelihood in the near future of any great change in this proportion.

It is desirable, therefore, to know more about tenant families and how they actually live as compared with owner families. Other factors the same, is their situation after all much worse than that of owners? How can tenant families be made more like owner families?

Family living data collected from 100 young, white farm-owner families, 117 young, white share-renter families, and 93 young, white sharecropper families during 1938-39 are available and will answer at least in part these questions. These families resided in Lauderdale, Clarke, Forrest, Itawamba, and Attala Counties, Mississippi, which counties all come in the 50 percent group of the State less desirable for permanent arable agriculture.[1]

This discussion will be limited to the situation of owner, share-renter and sharecropper families. Share renting and sharecropping are the most common forms of tenancy among white families of the State. The share renter furnishes his own mules and tools and receives three-fourths of the crop. The sharecropper furnishes labor only and receives one-half of the crop.

Description of Families

All families of this study were families in which the husband and wife had been married at least 1 year. All had kept house for 1 year. The wife was from 17 to 35 years of age in every case. Owner families averaged 4.6 members, sharecropper families 4.4 members and share-renter families 4.8 members. Owner and cropper families had the same number of children (an average of 2.4 children each) but owner families had more persons living in the family group other than children, and for this reason were a little larger.[2] Share-renter families averaged 2.7 children per family.

There were fewer owner families with no children than share-renter and sharecropper families, but share-renter and sharecropper families with children had more children. At the same age, wives

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[1] The eight bases for classification of counties into groups least suitable for permanent arable agriculture are given in "Current and Recent Land Occupancy with Particular Reference to Land Use." Land Use Planning Section, Land Utilization Division, Farm Security Administration, by C. O. Henderson, June 15, 1936.

[2] By average size of family is meant average number of members of economic family during report year counting membership per person per month as .083 member. Number of children is number of children at the end of the report year.

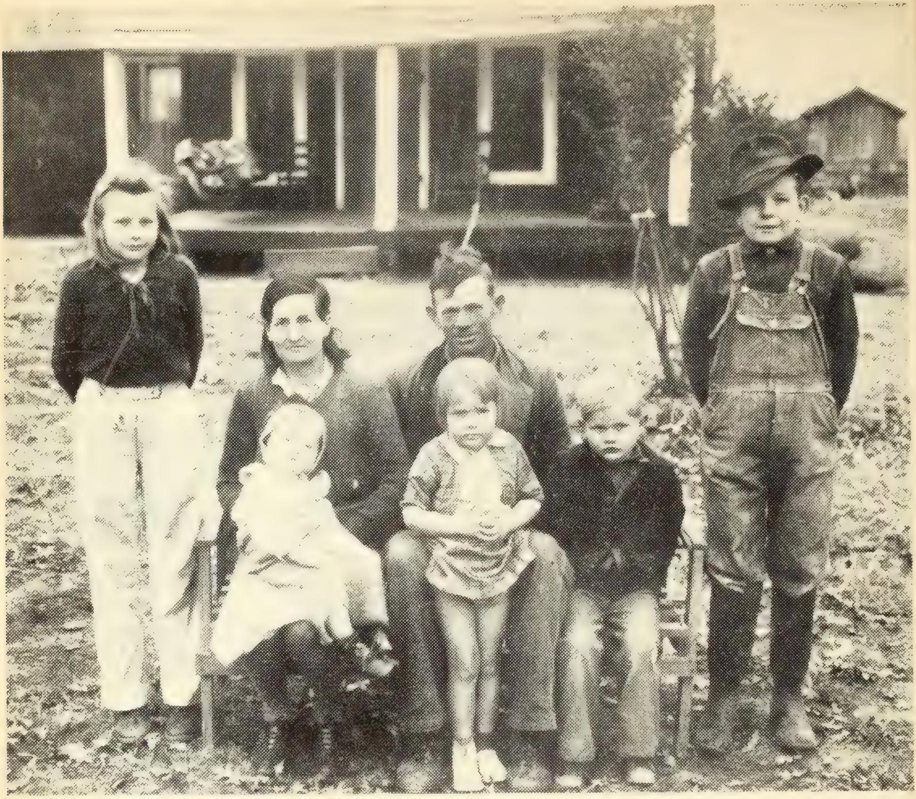

Figure 1.—An unusually successful sharecropper family. They are healthy because they are well-fed. Three hundred and seventy quarts of food were canned during the past year. Two milk cows are being purchased.

of tenants (share-renters and sharecroppers) have more children than do wives of owners. The fact that owner wives of this study averaged the same number of children as did cropper wives and nearly as many as did share-renter wives was because they were somewhat older. The median age (the figure that marks the dividing line between the upper and lower groups of wives classified by age) of owner wives was 30 years, of cropper wives 25 years, and of share-renter wives 27 years.

The majority of wives in all three groups had seven to nine grades of schooling. Husbands had slightly less schooling than did wives. There were, however, fewer wives of owners with little schooling than wives of tenants. Only 10 percent of the wives of owners had six grades of schooling or less, while 20 percent of the wives of share renters and 33 percent of the wives of croppers had as little schooling. A similar difference was likewise found in schooling of owner and tenant husbands.

FAMILY INCOME

What differences were there in the incomes of these three groups of farm families, similar in that they were all young, white housekeeping families in the same general type of farm areas, but different in respect to tenure under which they operated their farms. The median income of owner families was $723, of cropper families $408, and of share-renter families $512. Income included the total net money incomes received during the year by all members of the economic family from all sources, plus value of occupancy of homes, the value of home-grown food and other farm products used by the family, and the value of inventory change in livestock and crops stored for sale.

As may be noted from figure 2 [3] the majority of cropper families most often had incomes of $250 to $499. This was likewise true of share-renter families though not as frequently the case. Owner families most often had incomes of $500 to $749. What are some of the reasons for these differences?

As may be noted from table 1, there was no single reason for this difference. Income from all four sources listed was in every case less for sharecropper families than for owner families. In every case except non-farm money income, share renters occupied the middle position.

Farm Money Income Adjusted

Farm money income adjusted is the net return from farming. It includes the net money income from the farm and the inventory change. Eighty-five percent of the farm money income adjusted of owner families was net money income from

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[3] The table on which this graph is based, as well as tables on which the graphs which are to follow are based, can be secured by writing the Home Economics Department of the Mississippi Experiment Station.

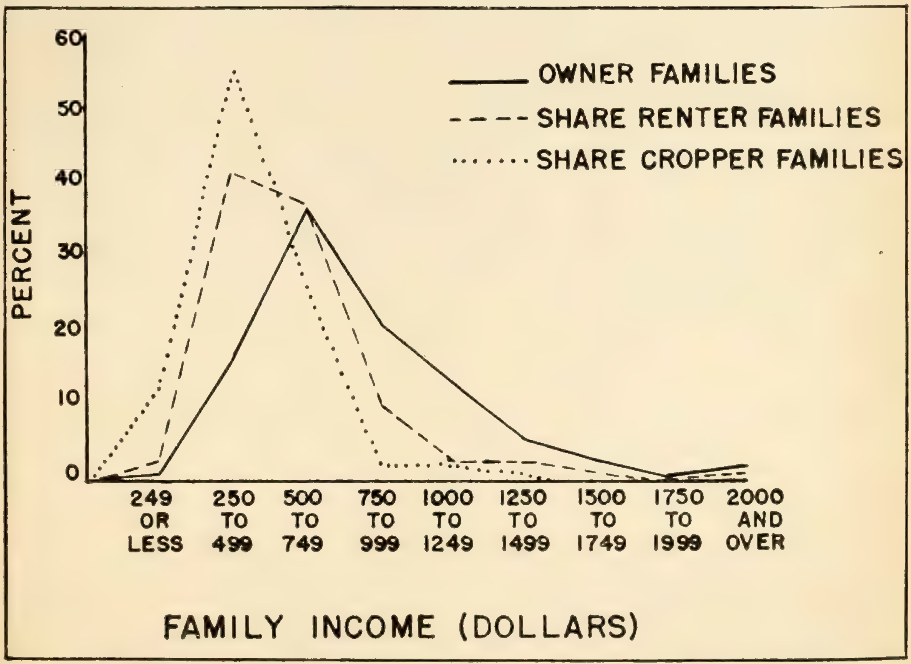


Figure 2.—Percentage of owner, share-renter, and sharecropper families having incomes of specified amounts.

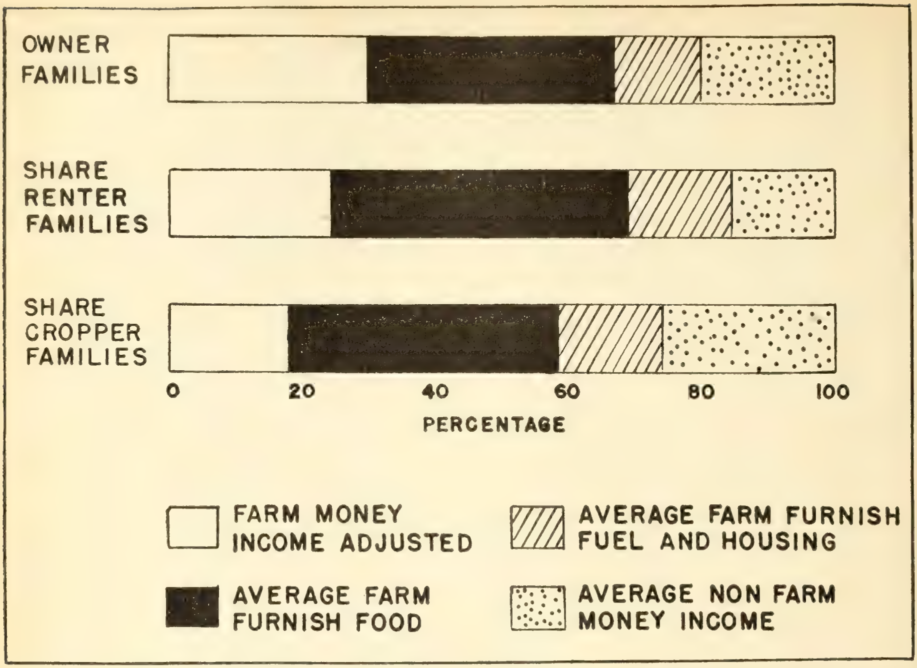


Figure 3.—Percentage distribution of total family income derived from specified sources of owner, share-renter, and sharecropper families.

Table 1.—Average amount of income derived from specified sources by owner, share-renter, and sharecropper families

Source of income	Tenure under which families farm: 100 owner families	117 share-renter families	93 sharecropper families
	Dollars	Dollars	Dollars
Average farm money income adjusted	237	140	89
Average farm furnished food*	294	258	194
Average farm furnished fuel* and housing**	101	89	75
Average non-farm money income	158	90	126
Total	790	577	484
	Percentage distribution		
Average farm money income adjusted	30.0	24.3	18.4
Average farm furnished food	37.2	44.7	40.1
Average farm furnished fuel and housing	12.8	15.4	15.5
Average non-farm money income	20.0	15.6	26.0
Total	100.0	100.0	100.0

*Value obtained by multiplying the quantity of products used, as reported by the family, by a price estimated for each locality. Price estimates were based upon what a sample of farm families in the locality reported they would have paid had they bought products of the same quality and in the same quantity from neighbors or from the most likely place of purchase.

**Owned houses were given rental values of 10 percent of the present estimated value of the dwelling, while 12 percent of the present estimated value of the dwelling was used for houses of tenants. These were the same percentages as used in the Consumer Purchases Study and were based on interest rates, taxes, depreciation, and a reasonable return on money invested.

farming, 15 percent an increase in inventories; i. e., an increase in livestock and crops stored for sale. Eighty-eight percent of the farm money income adjusted of the share-renter family and 96 percent of the sharecropper family was net money income from farming.

The three groups differed in the amount of farm money income adjusted more than in any other source of income (figure 3). Thirty percent of the total income of owners was derived in this manner, only 18 percent of the income of croppers was thus obtained.

There were several reasons for the differences in farm money income adjusted of the three groups. In the first place, owners cultivated more land than tenants. They cultivated on an average 35 acres. Share renters cultivated 27 acres, and sharecroppers 22 acres. There was only a small difference in favor of owners in income derived per acre cultivated.

Another explanation for greater farm money income of owner families was the greater diversity of crops offered for sale, made possible no doubt by more land and more capital. Owners had higher cash incomes and so could more easily finance the production of animal and truck crops. Then, too, they had more security for borrowing to purchase the needed supplies and equipment for such a program. A diversity of crops offered for sale meant that cash was available for family living throughout the year and better family planning was possible. Goods could be bought at a saving for cash. Advantage could be taken of specials.

Figure 4 shows the proportion of families in the three groups that produced for sale specified farm products. As may be noted, relatively the same (98 percent) in all three groups offered cotton and cottonseed for sale. This is, of course, the principal money crop of Mississippi farmers. The husbands and wives in these families were farm reared and had learned how to produce cotton on the farms of their parental families when cotton was the principal cash crop. Cotton production requires less labor than does the production of animal products and truck crops.

Fewer tenants than owners had had training in production of animal products and truck crops for sale. The successful production of these requires the acquisition of certain technical information. Husbands and wives of owner families had more often attended vocational and agricultural high schools where such information is given. They had had more contacts with agricultural agents who are students of scientific farming. The fact that a number of share-renter families were Rural Rehabilitation families of the FSA accounts no doubt in part for the good record of this group in comparison with the cropper group.

The owner had a greater return from farming than did the tenant, not only because he had more land and offered more crops for sale, but because of a greater increase in inventories. Because he earned more on the farm, he could keep the calf instead of selling it; he could hold his cotton to get a better price.

Farm Furnished Food

More important than net cash income from farming, however, was the value of food furnished by the farm. Net cash income for farming was for owners, share renters and sharecroppers $205, $124, and $85, respectively, while value of food furnished by the farm was $294, $258, and $194. In these poorer agricultural areas the majority of farm families produced most of the food they consumed, no matter what their tenure status. (Seventy-nine percent of the value of the food consumed by owner and share-renter families was home-produced, while 70 percent of the value of food consumed

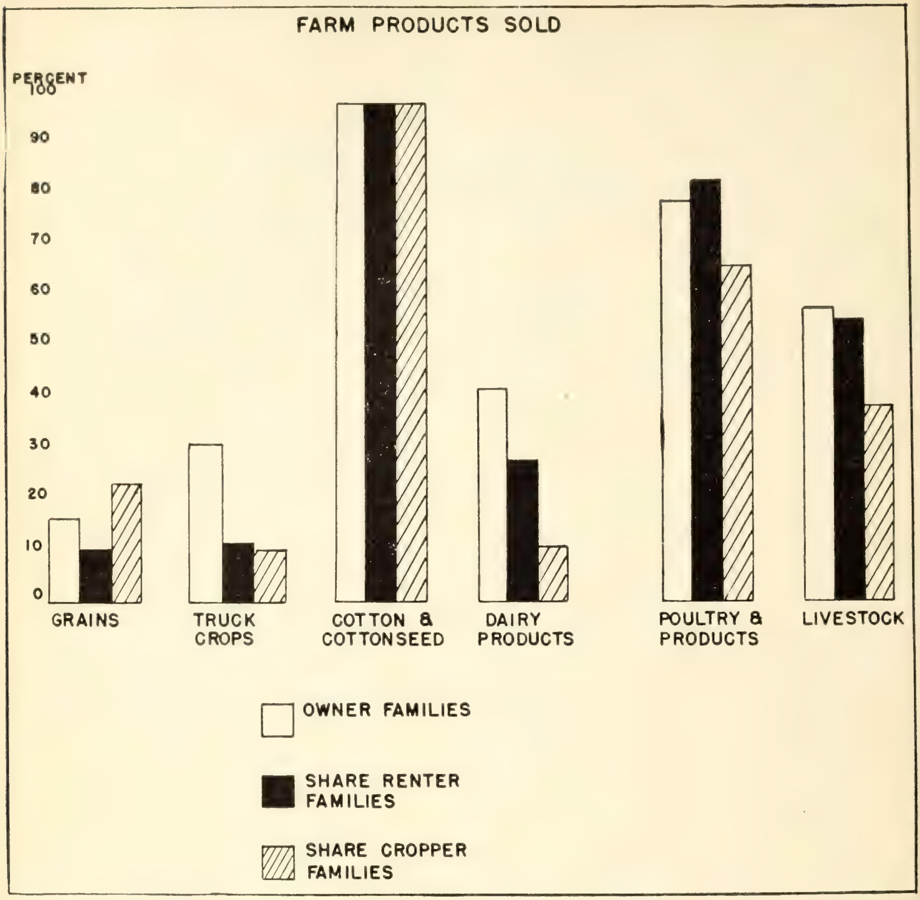


Figure 4.—Proportion of owner, share-renter, and sharecropper families selling specified farm products during 1938-39.

by cropper families was home-produced.) In this study it was not a question of "Produce for Home Use," but rather a question of produce for home use in quantities sufficient for optimum nutrition.

As may be noted from figure 5, the vast majority of owner, share-renter and sharecropper families produced some of each of the foods usually recommended by nutrition specialists. Table 2 tells us, however, that although 100 percent of the owner families produced some milk for home consumption, only two-thirds produced as much as recommended by nutrition specialists for families of their size and composition. The difference was even greater in case of cropper families. Eighty-seven percent of these families produced milk, but only 32 percent produced it in sufficient quantities for optimum nutrition for their families. Indeed, there is much more difference in the amount produced for home consumption by owners and croppers than in the number producing these products.

That so many of the tenants, sharecroppers as well as share renters, had a

Table 2.—Proportion of owner, share-renter, and sharecropper families producing specified foods in quantities recommended by nutrition specialists

Foods	100 owner families	117 share-renter families	93 sharecropper families
	Percent	Percent	Percent
Milk	67	56	32
Lean meat	42	30	26
Fruit	13	6	1

milk cow, a garden, poultry showed that they were really interested in producing "something to eat." That the amounts produced were below standards set by nutrition specialists showed that (1) these families did not know about these standards; or (2) these families were unable to meet these standards, perhaps because of limited technical information, acreage, or capital; or (3) these families were not interested enough in having the members of their family meet the food standards to do something about it.

Limited acreage was no doubt one factor in low food production. For this reason, it seems especially important for tenant families and especially cropper

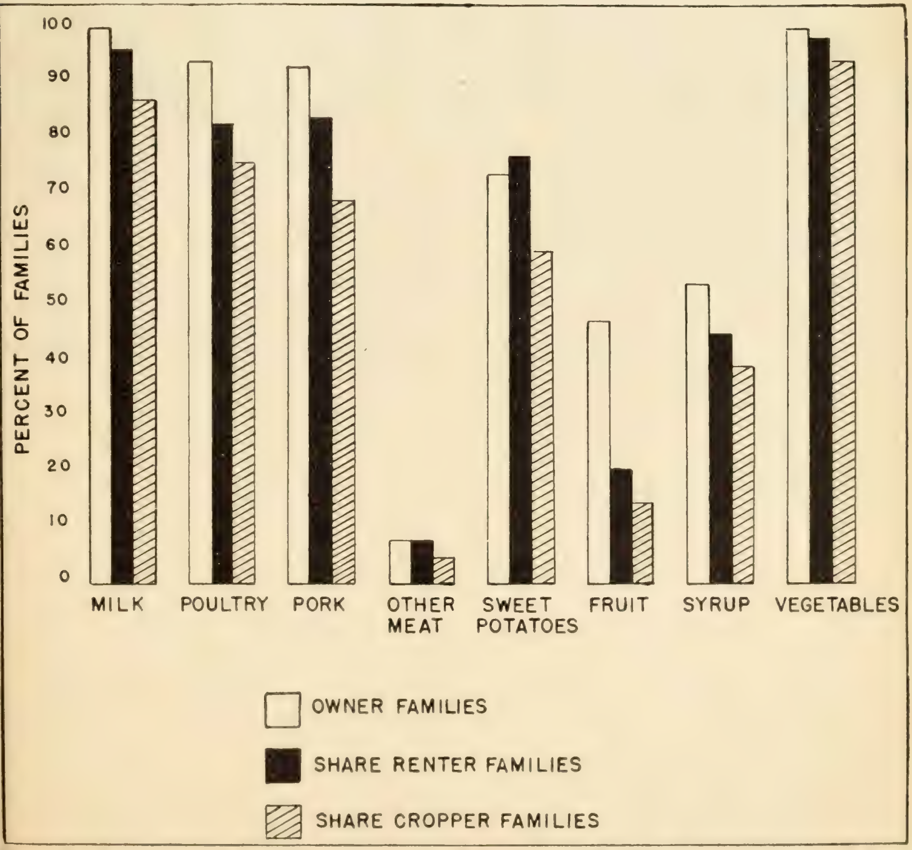


Figure 5.—Proportion of owner, share-renter, and sharecropper families producing specified foods for home consumption.

Figure 6.—Herds like this are one explanation for better economic status of some families in this study

families to concentrate their efforts on those foods that can be best produced on their particular farms.

Housing

Owners lived in houses which had an average value of $500. Share-renters' houses were valued at $360 and houses of sharecroppers at $290. Houses of owners were somewhat larger as well as in better repair. No family had modern plumbing facilities, but a few owners had water in their kitchens or on their porches. One-fifth of the owners had electricity. Very few tenants had this convenience. Most of the families who had electricity lived in the TVA area.

Forty-five percent of the homes of owners, 60 percent of the homes of share-renters, and 62 percent of the homes of croppers failed to meet the standard of one room per person. Most of the houses consisted of a kitchen and a bedroom or bedrooms. Few families, either owners or tenants, had separate living rooms. Eleven percent of the owners, 3 percent of the share renters, and 1 percent of the croppers had them. The majority of the families ate in the kitchen, but this practice was much more common among tenant families, only 30 percent of whom had separate dining rooms.

Non-Farm Money Income

As may be noted from table 1, farm owner families had $158 in non-farm money income. Share-renter families had $90 and sharecropper families $126. Fewer owner husbands than tenant husbands earned from work off the farm (68 percent), but those who earned in this manner earned more. Eighty-seven percent of the sharecropper and 79 percent of the share-renter husbands earned from work off the farm.

Sharecropper families more often received work relief during the report year than did families in the other two groups. Twenty-four percent had some work relief during the report year, while only

19 percent of the sharerenters and 11 percent of the owners had such assistance. Many of the families in this study mentioned need for more non-farm employment.

Cash earnings of husbands from work off the farm was the most common source of non-farm money income and accounted for more than 90 percent of this income in all three groups. The earnings of women and children were negligible. The children were young and the wife had little time for activities in addition to homemaking and assisting her husband in the farm business. Children in about 7 percent of the homes of tenants and 2 percent of the homes of owners earned. This was for the most part earned by chopping, hoeing, or picking cotton for neighbors.

Differences in Money and Non-Money Income

There are two ways of comparing incomes: by source (table 1) and by composition; that is, whether it is in the form of money or in the form of goods and services (table 3). For all three groups the value of non-money income (income in the form of housing, food, and other farm products and increase in inventories) was greater than was the money income.

Landowner families had higher incomes, both money and non-money, than did tenants. The money income of the share renter more nearly resembled the money income of the cropper; his non-money income more nearly resembled the income of the owner. Evidently, the share renter in these poorer agricultural areas was taking the first steps towards ownership, a "live-at-home program" and an increase in livestock.

TOTAL VALUE OF FAMILY LIVING

Value of family living consists in the sum of the value of goods and services that the family has without an expenditure of cash and in cash expenditures for family living. Value of family living averaged for owner families $704, for share-renter families $555, and for sharecropper families $474. There was then less difference in the value of family living in the three tenure groups than in their total incomes.

Cash Expenditures for Family Living

Cash expenditures for family living of share renters and sharecroppers were about the same (table 4). Owners spent about $100 more on family living than did these two groups of tenants, but they had about $150 more cash to spend. Differences in average size of family of the three groups was less than 0.5 person.

Differences in cash expenses for specified goods and services were caused by differences in number of families purchasing these goods and services as well as by differences in cash expenditures by those purchasing them. All families in the three tenure groups spent for food at home, for clothing, and for household operation. All owner families made expenditures for personal care; (i. e., toilet soap, cosmetics, hair cuts). There were, however, one or more families in every tenure group who did not spend during the report year for other goods and services listed in table 4.

As may be noted from figure 7, sharecroppers less often purchased certain of

Table 3.—Average money and non-money income of owner, share-renter, and sharecropper families

Kind of income	100 owner families	117 share-renter families	93 sharecropper families
	Dollars	Dollars	Dollars
Money income	363	214	211
Non-money income	427	363	273
Total income	790	577	484

Table 4.—Percentage of total cash expenditures for family living for specified goods and services classified by farm tenure of family

Goods and services	100 owner families	117 share-renter families	93 sharecropper families
	Percent	Percent	Percent
Food at home	25.4	32.5	41.2
Clothing and its care	20.7	21.9	18.9
Auto	11.5	5.5	5.2
Medical care	7.7	11.8	11.1
Household operation	6.6	5.6	4.8
Household equipment	5.8	3.9	3.4
Gifts*	4.1	1.8	1.3
Tobacco	3.6	4.7	4.8
Recreation	3.5	2.1	2.3
Personal care	2.5	2.4	1.8
Housing	2.3	.8	.1
Education	1.9	2.1	1.5
Other travel	1.4	2.1	2.5
Food away from home	1.2	1.8	.5
All other items	1.0	.6	.4
Reading	.8	.4	.3
Total	100.0	100.0	100.0
Total cash expenses	$309	$208	$205

*Includes taxes, as personal income taxes, poll taxes, and personal property taxes.

the specified goods and services than did owners. Thus, 83 percent of the sharecroppers did not have any expense for reading during the report year. Only 31 percent of the owners did not spend for reading. Fifty-six percent of the sharecroppers did not have an expense for gifts and community welfare; only 6 percent of the owners failed to have this expense. Relatively more share renters than sharecroppers had this expense, but fewer share renters than owners had it.

Food

There was a greater difference in cash expenditures for food by the three tenure groups than for any other goods or service (table 4). Forty-one percent of the cash expenses of sharecroppers was spent for food; only 25 percent of the cash expenses of owners went in this manner, but owners spent more for family living and would, therefore, spend relatively less for food for the proportion spent for food decreases as total expenditures increase. However, croppers spent absolutely as well as relatively more for food than did owners. They averaged about $84 per family for food, while owners (with $150 more cash income) averaged $78 per family. Share renters of this study spent on an average only $68 for food.

Sharecroppers had to spend more cash for food, because they produced less food on their farm than did the other two groups. Even then the total value of all food consumed averaged only 25 cents per family per meal, much too low a value on which to feed adequately a family of 4.4 persons.

Clothing and Personal Care

Share-renter families resembled more owner families than they did sharecropper families in the importance which they gave to clothing and personal care in their expenditures for family living. Greater expenditures for these goods and services were made possible by the saving which they made by producing more of their food on the farm.

Expenditures for personal care items

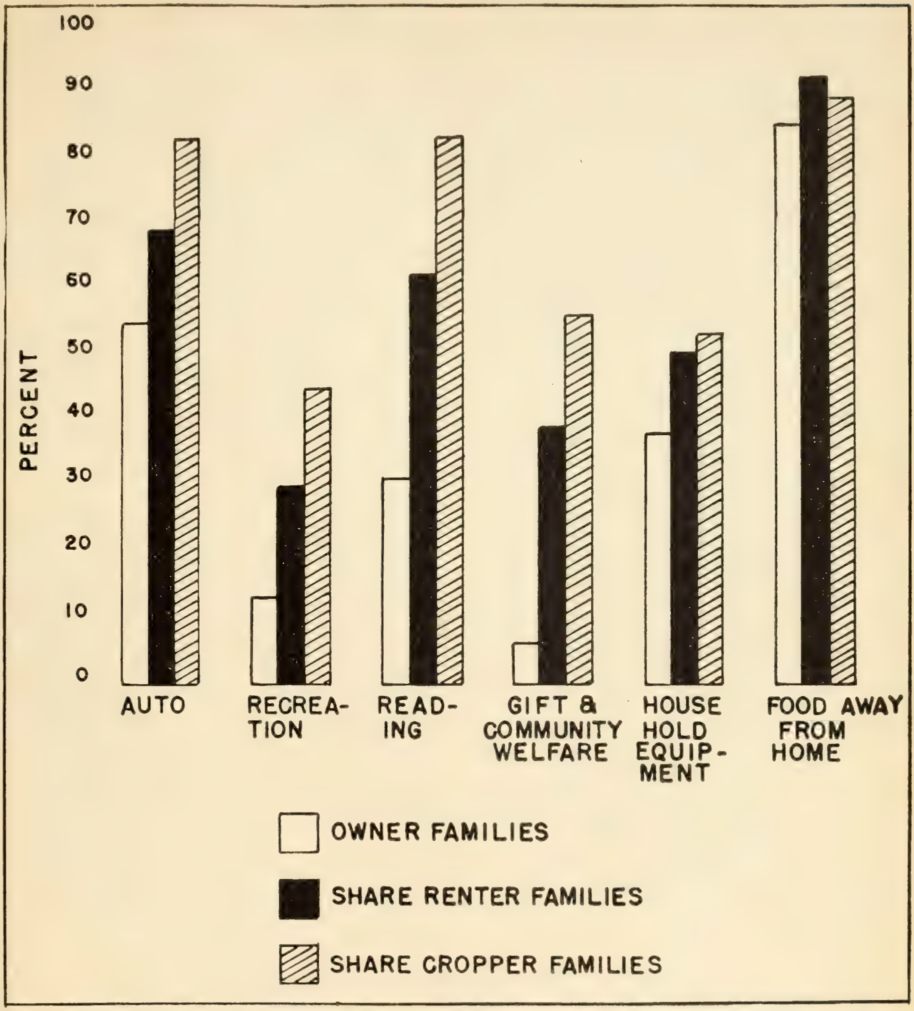


Figure 7.—Proportion of owner, share-renter, and sharecropper families not having expenses for specified goods and services during 1938-39.

such as hair cuts, waves, toilet soap, and cosmetics were small in all groups. Many of the services were obtained without money costs from neighbors. About 3 percent of the share-renter and 4 percent of the sharecropper families did not have an expense for personal care items during the report year. No owner family was without this expense.

The differences in cash expenditures for clothing do not accurately measure differences in clothing of the groups, for wives in some groups do more sewing than in other groups. Eighty-three percent of the owner families had a sewing machine. Sixty percent of the share-renter and 43 percent of the sharecropper families owned sewing machines. Little home sewing can be done without a machine. In fact, the sewing machine is to the clothing budget what the milk cow, the garden, and the orchard are to the food budget.

The House, Its Operation and Equipment

Fifteen percent of cash spent for family living by owner families was for the house, its operation and equipment Share renters spent 10 percent of their total expenditures and sharecroppers spent 8 percent in this manner. These expenditures were low for all groups, as many of the goods and services were furnished by the farm or performed by members of the family, or not available in the community—or if available, to be had only by spending large sums of cash.

Housing expenses for owners included minor repairs and insurance; for tenants, minor repairs paid by the tenant. (Rent, taxes, and interest were regarded as farm expenses. Improvements, additions, payments of mortgages were classed as an increase in assets.) Housing expenses of the owner families of this study were about four times such expenditures of share renters. Share renters more often made repairs on their houses at their own expense than did sharecroppers. This was due no doubt to the fact that share renters expected to remain in the house in which they resided for a longer period than did the sharecropper.

Repairs were needed which were not made in houses of families in all three groups, owners as well as tenants. But, so low were cash incomes of most of the families that expenditures were made for only those items considered most essential. Housing standards were on the whole low, lower than were clothing standards. This was perhaps because families with low housing standards had less opportunity for observing houses of families with higher housing standards than had families with low clothing standards opportunity for observing clothing of families with higher clothing standards.

As has been previously stated, all families of this study made an expenditure for household operation during the report year, though such expenditures in a number of cases were limited to kerosene, laundry soap, and matches. Fuel for heating and cooking was obtained by all families without money cost from nearby wooded areas. Only one family, a landowner, had daily household help. Only 18 of the 310 families here included hired laundry done during the report year. In most cases this was hired in an emergency such as caused by sickness in the home. Usually neighbors or relatives did the laundry for the family when the wife was sick.

The families of this study lived in rather thinly populated areas. Ice routes were not common and consequently the use of ice was limited since one must go to town to get it. Only 37 percent of the owners had refrigerators or ice boxes: 13 percent of the share renters and 10 percent of the sharecroppers had them. Cisterns and wells were used by some to keep food cool.

Thirty-eight percent of the owner families, 50 percent of the share-renter families, and 53 percent of the sharecropper families did not make an expenditure for household equipment during the report year. Owners who had such expenditures averaged $29, while share renters and sharecroppers with this expense averaged $16 and $15, respectively. Owner families had more household equipment as well as household equipment of better quality than did share renters and sharecroppers. The equipment of share renters was on the whole somewhat better than that of sharecroppers. Thus, for instance, 7 percent of the families of sharecroppers had congoleum on their kitchen floors: 10 percent of the families of share renters and 31 percent of the families of owners had this kitchen floor covering.

Auto and Other Travel

Families in all three tenure groups spent more for auto than they did for other travel. Forty-five percent of the owner families, 21 percent of the share-renter families and 17 percent of the sharecropper families had expenditures for auto during the report year. For use of the auto by the family, owners with autos averaged about $90 expense; tenants with autos averaged about $60. Share renters and sharecroppers differed little in this respect.

Recreation and Tobacco

Tobacco is classed here with recreation as it is a form of recreation, especially for low income families. About the same proportion of the total family living expense of owner families was spent for recreation as for tobacco. Tenants spent relatively twice as much for tobacco as for recreation. Expenditures for recreation included for the most part expenditures for toys, hunting licenses and shells, and radios and radio supplies. 41 percent of the owners had radios while only 20 percent of the share renters and 14 percent of the sharecroppers had them. Little was spent for paid admissions to movies, plays, concerts, ball games, dances, and the like.

One of the favorite forms of recreation of families in all three groups was visiting with relatives and neighbors. Some visiting was carried on at church. About two-thirds of the owner families, one-third of the share-renter families, and one-twelfth of the cropper families attended church once a month or more. Greater church participation of owner families was possible because owners more often owned autos, had more and better clothng to wear to church, and more cash to contribute. Ninety-four percent of the owner families, 61 percent of the share-renter families, and 44 percent of the harecropper families had expenditures or gifts and community welfare during the report year. A large proportion of these expenditures was in the form of contributions to church. Participation of share-renter families was greater than of sharecropper families, because in the first place, they had usually resided a greater period in the community and had thus had more time to establish church ties. Because of more food production on the farm and less to purchase, they had a little more cash available for "Sunday clothes" and the "collection plate." The church was the voluntary social institution with which these families most often participated.

Figure 8.—A typical rural church where people visit with each other before and after services.

Medical Care

Expenditures for medical care took fourth place in family living expenses of farm owner families and third place in family living expenses of farm tenants (table 4). Families in all three groups averaged about $25 for such care. There was, however, less sickness in owner families than in share-renter or sharecropper families. Forty-eight percent of the owner families had no sickness of 3 days or more duration in their families during the report year; only 42 percent of the share-renter families and 34 percent of the sharecropper families were as fortunate. Share renters and sharecroppers could and would have spent greater sums for medical care had they had such sums.

CHANGES IN NET WORTH

Change in net worth includes the net change in family assets and liabilities resulting from actual money transactions and the net increase or decrease in value of crops stored for sale or of livestock owned. Owner families averaged an increase of $107; cropper families a decrease of $10. Share-renter families had a net increase of $17 (table 5).

It is important to know not only net surplus or deficit, but how many families in each of the three groups had them. Figure 9 gives this information. As may be noted, about one-third of the owners and one-half of the sharecroppers had a deficit; six-tenths of the owners, four-tenths of the sharecroppers had a surplus. The proportion of share renters with deficits was greater than for owners, but less than for sharecroppers. The proportion with a surplus was less than for owners, but greater than for croppers.

The most frequent cause for deficits of all three groups of families, but especially sharecroppers, was an increase in debts for family living during the report year. Many of the families got in debt before the sale of crops in the fall. To tide over weeks and months when little cash income was received they bought on

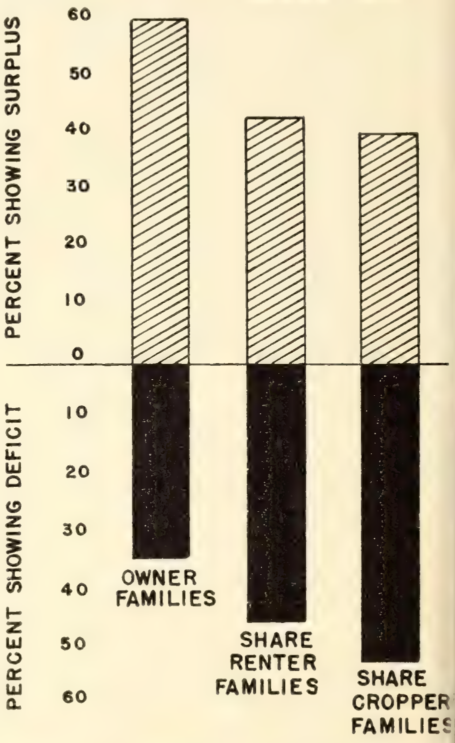


Figure 9.—Distribution of owner, share-renter, and sharecropper families having surpluses and deficits.

Table 5.—Average change in net worth of owner, share-renter, and sharecropper families

Item	100 owner families	117 share-renter families	93 sharecropper families
	Dollars	Dollars	Dollars
Net surplus or deficit*	75	1	-14
Change in livestock and crops stored for sale	32	16	4
Change in net worth	107	17	-10

*Average net surplus or deficit does not equal the exact difference between net cash incomes and net cash expenses. In accepting a schedule an error of 10 percent of the income or expenditures, whichever was greater, was permitted.

credit at a higher price. The next cause in importance for deficits was an increase in farming debts. Owners were more likely to have deficits brought about by reduction in saving accounts or by sale of assets to raise cash than were tenants.

The most frequent method of providing for the future in all groups was by burial insurance. Sixty-five percent of the owner families, 57 percent of the share-renter families, and 45 percent of the sharecropper families made payments during the report year on burial policies. Only seven owners and two tenants had life insurance. During the report year 30 percent of the owner families made payments on mortgages of farm and home. Three share renters and 1 sharecropper made payments on land.

Investment in farm equipment was almost as common among share renters as among owner families. Croppers seldom purchased farm equipment, for such equipment is customarily furnished the cropper by the landowner.

LEVELS OF LIVING OF TENANT AND OWNER FAMILIES

It was the purpose of this report to determine how levels of living of tenant families might be raised. Since owner families usually have higher levels of living than do tenant families, one way of determining how this may be done is to compare levels of living of tenant families with similar families who own. Differences found can be used as a basis for suggesting how better family living might be attained by tenants. This is the method used in this study which includes 100 owner families, 117 share-renter families, and 93 sharecropper families. All the families were young, white families with wife 17 to 35 years of age. All resided in poorer agricultural areas of the State. The families in the three groups averaged about the same number of family members—4.6 members for owners, 4.8 members for share renters, and 4.4 members for sharecroppers.

The income of owner families averaged $790, of share-renter families $577, and of sharecropper families $484. There was no one reason for differences in the incomes of these three groups. Returns from farming, value of housing, and of products furnished by the farm and money income from non-farm sources were all greater for owner than for tenant families. Returns from farming and value of housing and of products furnished by the farm were greater for share-renter than for sharecropper families. The money income from non-farm sources was, however, greater for sharecroppers than for share renters due to the fact that more of the sharecroppers had received work relief during the report year.

Both money and non-money income of owner families were greater than that of tenant families, but money income of share-renter and sharecropper families was about the same (one group earned more from the farm; the other off the farm). Non-money income of sharecropper families, however, was about $100 less than of share-renter families; that is, sharecropper families lived in poorer houses, produced less food and less often had an increase in inventories than did share-renter families.

Cash expenditures for family living were about $100 greater by owner families than by tenant families. Share-renter and sharecropper families had about the same cash expenditures, but share renters spent less for food because they produced more at home. In this way, they had somewhat more to spend for clothing and community welfare and thus participated more in social institutions of the area than sharecropper families.

Thirty-four percent of the owner families, 45 percent of the share-renter families, and 52 percent of the sharecropper families showed a net deficit during the report year; 60 percent of the owner, 43 percent of the share-renter, and 40 percent of the sharecropper families showed a net surplus. The most frequent cause for deficits of all three groups of families, but especially of sharecroppers, was an increase in debts for family living.

IMPROVING LEVELS OF LIVING OF TENANT FAMILIES

From the study of levels of living of young owner, share-renter, and sharecropper families in poorer agricultural areas of Mississippi, it would seem that improving levels of living of tenant families in such areas would involve:

(1) More attention to the use to which each acre is put. From the view-point of family planning, it is most important that receipts from the sale of farm products be distributed throughout the year. Forty dollars every 2 months is better, for instance, than $240 in the fall. Especially important is this distribution to low income families, such as farm tenants, who must pay more for their goods and services because they do not receive their income until after the crops are harvested and have little or no security to offer in the meantime.

(2) Producing more food for family consumption. When well planned food production programs are carried out, the family benefits directly from a better food supply and indirectly since cash otherwise needed for food can be released for other purposes.

(3) Making simple repairs on buildings and premises. Many of the houses were in a poor state of repair and some of these repairs could have been made without cash expense, or with very little cash expense, and the tenant families of this study could have lived more conveniently and comfortably.

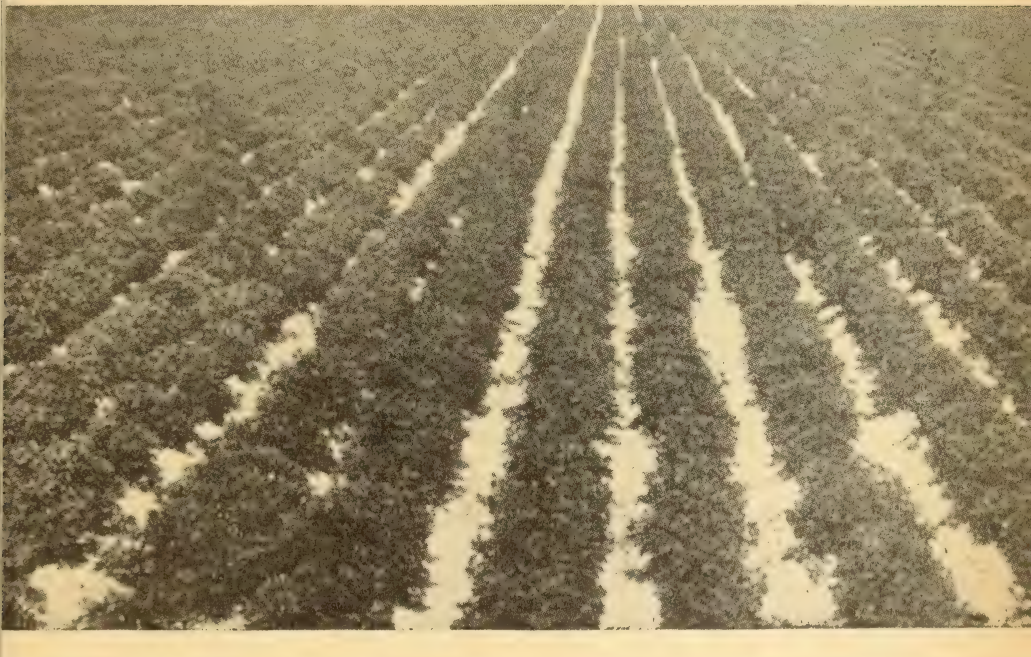
(4) Training in non-agricultural pursuits of a semi-skilled and skilled nature would have made it possible for many of the tenants of this study to have earned more from non-farm activities. Most of the tenants who earned from work off the farm did so by common labor. Practically no tenant of the study devoted more than 7 months of the year to farming, many devoting even less time. Opportunities which are now available for securing vocational training need to be used by more tenants. Communities making no provision for such training should do so. Training in carpentry blacksmithing and the like will increase income in two ways: (a) Make possible greater non-farm earnings (b) reduce cash expenses which tenants pay for such services.

(5) A better understanding by members of the family about the qualities in goods and of services that make them suit their purpose. Such information is taught by home economists in schools agricultural extension clubs, Farm Security Administration home managemen groups, but needs to be known by everyone who buys—by men as well as by women.

(6) A feeling of need by the members of a family for improved standards of living. To really want a high level of living is the first step in securing it. The test of desire is willingness to work for what is desired.

BULLETIN 366 (Revision of Bulletin 341)   MARCH 1942

Peanut Production



Compiled by H. O. WEST, Research Coordinator

Jointly Representing Mississippi State Vocational Board
and : : Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
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Peanut Production

Compiled by H. O. WEST*

In the past peanut production has not been very widely distributed in Mississippi, but during the last few years considerable interest has been manifested in several sections of the State toward the expansion of peanut production. Along with this increasing interest in peanut production there is a demand for information by agricultural workers and by farmers on the best methods of producing peanuts.

There has been only a limited amount of experimental work conducted by the Mississippi Experiment Station with peanuts, which made it necessary to seek experimental and other reliable information from other states in preparing this compilation on peanut production. Therefore, the experimental information in this compilation includes appropriate material from a number of peanut producing states, and is supplemented with general information pertaining to the practices of peanut growers from a peanut producing area. Much information was secured from farm surveys made for the purpose of this publication on twenty-four farms in Southeast Alabama. The practices used on these twenty-four farms were summarized and used in this compilation to supplement experimental information.

Experiment station results indicate a wide variation in the response of peanuts to fertilization, which makes it difficult to know what is the best practice to follow, and while certain prevailing farm practices are cited, there is no way of knowing that the practices used by the peanut growers of Southeast Alabama are the best practices to use. The available experimental information, and the practices used in Southeast Alabama are presented in this compilation to be used as a guide in the production of peanuts.

FARM ORGANIZATION

The success of peanut production as well as any other farm enterprise will depend to a considerable extent on how well it fits into the general farm organization. It is a known fact that there are always certain risks and hazards involved with the introduction of a new enterprise. However, in certain areas of Alabama, North Carolina, Virginia, Georgia, and Texas the peanut crop occupies a very important place in the farm organization, and supplies a great deal of the farm income of these areas.

The 24 farm surveys, referred to in the introduction, were made in Houston and Coffee counties in the heart of Southeast Alabama's peanut producing area. Peanuts occupy an important place in the farm organization and income of these counties.

Houston and Coffee counties have a cotton acreage allotment of 92,700 acres, and an allotment of 70,500 acres for harvest peanuts. These two acreages equal 40.2% of the total cultivated land. In addition to the harvest peanuts, 61,000 acres are planted solid in peanuts and 60,000 acres a row of corn and a row of peanuts; these peanuts are harvested with hogs produced for home use and for the market.

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*Jointly representing Mississippi Agricultural Experiment Station and Mississippi State Vocational Board.

Houston and Coffee counties have 406,000 acres in cultivation. With the farm organization prevailing in these counties, over 50% of the cultivated land is producing cash income. In making the farm surveys on the 24 farms of these two counties the farming system used on each farm was secured including crops grown, livestock population and the acreage, yield, and sales from each enterprise. The twenty-four surveys were summarized and show the following:

SUMMARY OF 24 FARMS SURVEYED IN SOUTHEAST ALABAMA, JANUARY 1940

By E. P. Rawson and H. O. West

Total acreage in farms	6085	Average per farm	253.5
Total acreage in cultivation	3663	Average per farm	152.6

Crop	Total of 24 Farms			Average Per Farm		
	Acreage or head	Production	Sales $	Acreage or head	Production	Sales $
	Acres					
Cotton	780	517 bales	$22,467.50*	32.5	21.5 bales	$936.52
Corn	952	15324 bu.	80.00	39.6	638.5 bu.	3.33
Peanuts (harvested)	507	289 tons	14,921.00**	21.1	12.04 tons	621.70
		lbs. pork			lbs. pork	
Peanuts (hogged)	653	194115	11,687.00	28.4	8088	478.60
Corn and		3107 bu.	0	12.0	129 bu.	
Peanuts	289	45650 lbs pk	2,282.50		1902 lbs pk	95.00
		Grain and			Grain and	
Oats	305	hay	175.00	12.7	hay	7.29
		lbs. pork			lbs. pork	
Soybeans	45	9100	455.00	1.87	380	19.00
Miscellaneous crops	45		910.00	1.87		38.00
	Head	lbs pork			lbs. pork	
Hogs	1655	310,175	17,237.00***	69.0	12924	718.20
Beef cattle	53		1,800.00	2.2		75.00
Dairying	64		3,182.50	2.66		132.60
Poultry			587.00			24.40
A. A. A. Payment			9,053.00			377.20
	TOTAL INCOME		$70,413.00	AVERAGE INCOME PER FARM		$2,933.90

*8.69c per lb. lint cotton

**$51.63 per ton

***5.55c per lb.

The farm surveys were made at random in Houston and Coffee counties, Alabama. These farms were not selected as representing the best or poorest in the area. The surveys were made on farms where the owners were found at home.

The soils on these farms are Greenville, Orangeburg, Norfolk, Ruston, Savannah, Luverne and Susquehanna. The class is sand to clay, with a high percentage of fine sandy loam. The soils are fairly fertile, producing very satisfactory yields of most crops.

In grouping the farms in high, medium, and low acreage groups, the high group of 8 farms averaged 481 acres in the farms with 284 acres in cultivation; the medium group of 8 farms averaged 218 acres total with 131 acres in cultivation; and the low group of 8 farms averaged 61 acres total with 42 acres in cultivation. The per farm income on these farms ranged from $293 to $12,800.

This study is presented here to show how peanuts fit into the general cropping system and the position they occupy in supplying income, and to serve as a guide as to what to expect with a similar cropping system and similar conditions.

SOILS AND CLIMATE

Peanuts can be produced on practically all of the soils of Mississippi. The best quality and largest yields of marketable peanuts are produced on the well-drained, light sandy loam soils. The dark colored soils stain the hulls of the peanuts, and may affect the price secured, depending on the use made of the nuts. Stained pods are not objectionable for shelling stock or oil purposes. Soils which pack or bake easily are not well suited for peanuts, as it is hard for the "pegs" or stems to enter such soils. The peg or stem must enter the soil to form a peanut. When the peanuts are grown for hogs, any kind of soil that is loose and well-drained may be used. Poorly drained or sour soils are not generally desirable for peanuts. The North Carolina experiment station has found that peanuts produce higher yields per acre on soils with a pH above 5.0.

Peanuts will adapt themselves to a wider range of climate if soil conditions are favorable, than almost any other southern crop. The climatic requirements of the peanut are: a growing season of 100 to 140 days without frost, moderate rainfall during the growing period, an abundance of sunshine, and a relatively high temperature. Best results are secured under conditions where the normal annual rainfall is from 42 to 54 inches. Peanuts are frequently grown under irrigation; however, fair yields have been made without irrigation where the annual rainfall is less than 19 inches. On the other hand, good crops have been produced on low, bottom soils with 54 to 60 inches of rainfall. Peanuts do not grow well at high elevations, even when there are more than 130 days between frosts, as the cool nights in these localities prevent proper development of the crop.

The soils in the peanut section of Southeast Alabama are in general the sandy type, with many different soil series usually similar to and often identical with Mississippi soil series. In the production of peanuts, as any other crop, the more fertile the soil the higher the yield of peanuts per acre.

References: Virginia Agricultural Experiment Station Bulletin 218, "Peanut Culture," pages 4 and 5, January 1918, Blacksburg, Virginia.

Farm surveys of Southeast Alabama.

North Carolina Experiment Station Agronomy Information Circular 123, January 1940, Raleigh, North Carolina.

Farmers' Bulletin 1656, "Peanut Growing," pages 1 and 2, February 1931.

LAND PREPARATION

Proper land preparation for peanuts is important. Some farmers believe in fall plowing and consider it to be the most satisfactory way of getting a good seedbed. In many sections of Mississippi, soil erosion must be considered in connection with fall plowing. Many times fall plowing causes an excessive amount of erosion and if this practice is carried out for a few years a field or given area may be completely ruined. However, most peanut land is broken six to eight weeks before planting time.

The farmers interviewed in Southeast Alabama begin breaking their land in December and continue plowing during suitable weather until their land is broken. By doing this the grass and litter on the ground is given time to decay before planting time. If the land is not broken, usually a disk harrow is used in November or early December to cut the litter into the soil to speed up the decaying process. In this section all peanut land is flat broken, and allowed to stand until just before planting time.

The land should be clean and free from trash at planting time. A good seedbed will help to get a good stand, and lower the cost of cultivation. A rough seedbed will cause the planter and cultivating implements to clog. The operator will waste considerable time trying to get the implements to work, and drag up a lot of plants, resulting in an uneven stand and lower production. By breaking or disking early enough to allow the litter to decay and to provide a firm seedbed at planting time these inconveniences may be overcome.

About ten days before planting time, the farmers of Southeast Alabama bed their peanut land with a middlebuster, one furrow to the row. It is allowed to stand this way until ready to plant.

References: Farmers surveyed in Southeast Alabama. Tom Houston Peanut Company Bulletin.

VARIETIES

In planting any crop a decision must be made as to what variety to use. Everyone is interested in securing the variety that will give the largest yield or cash return. There are several varieties of peanuts, but two main types: the bunch and runner. The bunch type usually mature quite a bit earlier than the runner type. Bunch type peanuts must be harvested immediately when mature, whereas the runner type may remain in the soils for a considerable period without injury.

In studying a summary of the farm surveys made in Southeast Alabama it was found that a large percentage of the peanuts planted are North Carolina runners. Taking the entire Alabama peanut belt, it is estimated that 85 percent of the peanuts are North Carolina runners and 15 percent Spanish. Very few Spanish peanuts are harvested in Alabama because the farmers say that they have to be harvested the last of August or first of September during the peak of the cotton picking season. Therefore, most Spanish peanuts are hogged in Alabama and the runners are harvested for the market. These farmers report little difference in returns from different varieties. The Spanish usually bring more money per ton but the runners produce enough more per acre to make up for the difference in price.

In selecting a variety it would be wise to consider the use to be made of the peanuts and the time and method of harvesting, to avoid a labor overload at harvesting time.

Peanut Variety Test

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1928-1937.

Purpose: To determine the best variety of peanuts to grow.

Soil: Tifton sandy loam.

Procedure and Conditions: This test was run in two replications on 1/40 acre plots. The plants were spaced 6 inches apart in rows 3.3 feet wide. The fertilizer was applied at planting time, stirred in the furrow. The average planting date was April 10.

Spanish and Improved Spanish are bunch varieties grown mostly for market, although sometimes used for early hog grazing. These two varieties are easy to harvest, have a high shelling percentage and are in good market demand. Spanish peanuts sprout badly soon after maturing and for this reason are not suited for late hog grazing. North Carolina Runner makes a high yield, keeps well in the soil after maturing and is used largely for hog grazing. This variety is harder to harvest than Spanish, has a lower shelling percentage and brings a lower price on most markets.

Results:

VARIETY TEST WITH PEANUTS

400 Lbs. 2-10-4** (Ammonia, phosphoric acid and potash)

Variety	Pounds Per Acre											Shelling %
	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	10yr. Av.	28-37
North Carolina	1242	1915	1634	1918	1960	2135	1665	2180	1757	2165	1858	70.2
McGovern	1130	1762	1463	1911	1844	2090	1700	2050	1555	2180	1769	70.3
Improved Spanish	1604	1320	1190	1493	1428	1932	1259	1599	1520	1890	1523	67.9
Spanish	1557	685	1130	1493	1640	2205	1175	1448	1457	2058	1484	76.3
Chapman's Pride	1612	917	899	1553	1311	1810	1190	1443	1144	1855	1373	65.0
Valencia	882	485	462	893	986	1590	980	——	——	——	897*	60.0

*7-year average

.**2-10-4 ammonia, phosphoric acid, potash

Reference: Fourteenth, Fifteenth, Sixteenth, Seventeenth and Eighteenth Annual Reports of the Georgia Coastal Plain Station, Tifton, Georgia.

Peanut Variety Test

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Edisto Experiment Station, Blackville, South Carolina.

Period: 1941.

Purpose: To compare the different varieties of peanuts.

Soil: Mixed phase Marlboro-Norfolk.

Procedure and Conditions: In this series of tests 300 pounds of a 3-8-8 mixture plus 300 pounds of Dolomitic limestone per acre was applied in the drill on April 28, 1941 and the peanuts were planted April 29, 1941.

Results:

PEANUT VARIETY TEST

Variety	Yield in Pounds Per Acre
Hasting's Improved Spanish	1420
Wood's N. C. Runner	1395
Small Spanish	1310
Wood's Improved Spanish	1260
Hasting's Valencia	1215
Wood's Valencia	1000
Wood's Tennessee Red	960
Wood's Virginia Bunch	945
Florida No. 118	905

Reference: Report of South Carolina Agricultural Experiment Station at Peanut Fertilizer Conference in Atlanta, Georgia, March 11, 1942.

Variety Test with Peanuts at Angleton, Texas

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Angleton Station, Angleton, Texas.

Period: 1915-1933.

Purpose: To determine the best variety of peanuts to plant at Angleton, Texas.

Soil: Light colored phase of Lake Charles clay and clay loam soils. The Lake Charles soils are black to dark gray in color and range from clay to fine sandy loam in texture, although the clay is the most extensive type. These soils have dark-gray, heavy clay subsoils. They contain a larger proportion of clay than is desirable from the standpoint of ease in harvesting peanuts.

Procedure and Conditions: The peanuts in these experiments were planted in three-foot rows. During the period of the experiment the size of plot ranged from 1/44 to 1/11 of an acre, but since 1927 the plots have been 1/22 of an acre in size, consisting of two rows 330 feet long.

In these studies the peanuts followed corn in the four-year rotation of corn, cotton, corn and peanuts. During the last six years, however, grain sorghum occasionally replaced the corn in the rotation. After harvesting, the stalks of cotton, corn, and the grain sorghum usually were plowed under in the fall or winter as conditions permitted. The entire peanut crop, including vines and nuts, was removed from the land in harvesting.

Generally the peanuts were planted flat on land that had been plowed the preceding fall or winter. In some years, however, low beds were formed on the plowed land with a cultivator and the peanuts planted on these beds. Prior to 1920 the seed was dropped by hand but since that time the seed has been planted with a duplex hopper attachment on a lister planter. In the spacing tests the peanuts were dropped by hand.

As a rule, the small-podded varieties were not shelled before planting but the pods were broken crosswise so that a single kernel was dropped in each hill. The large-podded varieties, however, were shelled because the kernels usually do not fill the pod and have a tendency to drop out if the pods are broken, so that an empty hull would not be planted instead of a kernel.

The date of planting ranged from March 15 to June 5, but usually the peanuts were planted the latter part of April or first part of May.

Occasionally it was necessary to replant the peanuts because of thin stands resulting from low germination of seed, from unfavorable weather conditions immediately after planting, or from damage caused by rodents. Further, the final stands obtained were poor in most years.

The peanuts were given about the same cultivation as cotton. Shallow clean cultivation was practiced. From three to five cultivations were given during the growing season. As a rule the peanuts were hoed twice and occasionally three times, which was one more hoeing than was given cotton.

The peanuts were dug with a walking mouldboard plow. As a rule the row was barred off and then the center strip containing the plants was turned over. The vines were then shaken out of the soil with a pitchfork and all of the plants on each plot, consisting of two or three rows, were heaped together for drying.

Miscellaneous: The average yearly rainfall at Texas Substation No. 3, located at Angleton in the Gulf Coast Prairie, approximately 18 miles from the Gulf of Mexico, was 44.53 inches for the 19 years, 1915-1933. While the monthly and yearly rainfall is ample, the distribution often varies widely in individual months and years.

The temperature during the growing season is favorable to the growth of peanuts. The mean maximum temperature ranged from 78.4° F. in April to 92.2° in August. The mean maximum temperature ranged from 57.8° F. in April to 71.9° in July.

Results:

YIELD OF PEANUTS IN POUNDS PER ACRE IN THE VARIETY TEST

Year	Small-pod varieties*		Large-podded varieties**				
	Macspan	Spanish	Runner Carolina	Runner Virginia	Virginia Bunch	Valencia	Tennessee Red
1915	——	1434	——	——	931	1938	1426
1916	——	6048	——	4011	——	2926	2605
1917	——	1890	——	2363	——	1288	1701
1918	——	810	——	499	——	381	409
1919	——	87	——	128	95	68	——
1920	——	1500	——	——	1302	484	717
1921	——	672	——	480	576	451	660
1922	2391	1878	——	873	2233	1549	671
1924	528	309	——	486	1434	1085	836
1926	——	210	——	1269	700	706	506
1927	420	696	1159	356	805	257	216
1928	1158	1053	673	1054	739	552	455
1929	1740	1596	1157	1489	1167	810	1078
1930	1386	1842	2328	1085	1428	713	614
1931	1434	1152	979	1060	867	636	552
1932	1470	1449	968	519	497	447	326
1933	1422	1089	988	836	295	389	440
Average 1927-33	1290	1268	1179	914	843	543	526
Av. 1927-33 Bu. per A.	43.0	42.3	53.6	41.6	38.3	24.7	23.9

*A bushel weighs 30 pounds.

**A bushel weighs 22 pounds.

Reference: Texas Agricultural Experiment Station Bulletin 503, "Peanut Growing in the Gulf Coast Prairie of Texas," pages 6, 7, 8, 9 and 11, table 3, College Station, Texas, January 1935.

Peanut Variety Tests in Texas

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Beeville, Troup, Angleton, Lubbock, and Nacogdoches, Texas.

Period: 1 to 10 years.

Purpose: To test the different varieties of peanuts.

Procedure and Conditions: Yields will vary with the season and the fertility of the soil. The peanut if grown continuously on land with both the forage and nuts removed, will soon deplete the soil, resulting in greatly reduced yields.

Variety tests, in which both nut and forage yields were recorded, have been conducted at six of the Texas Substations. Results of these tests are summarized below.

Results:

AVERAGE YIELD PER ACRE IN BUSHELS OF NUTS AND TONS OF FORAGE OF PEANUT VARIETIES TESTS AT FIVE SUBSTATIONS IN TEXAS

Station	Years Tested	Spanish		Tenn. Red		Valencia		Va. Runner		Va. Bunch	
		Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage
Beeville	1	46.12	2.79	24.84	2.41	28.40	2.72	37.91	2.50	18.57	1.86
Troup	8	34.52	1.39	23.79	1.16	54.60	1.70	28.52	1.35	......	......
Angleton	10	53.52	1.56	30.37*	1.54*	46.21	1.14	......	......	64.27	1.07
Lubbock	1	23.30	.35	21.82	.33	......	......	22.73	.30	21.36	.18
Nacogdoches	1	......	2.18	......	1.89	......	......	......	1.93	......	1.52

*4 years.

Reference: Texas Agricultural Experiment Station Bulletin 381, "Peanuts in Texas," pages 16 and 17, table 6, May 1928, College Station, Texas.

SEED SELECTION

Pure, unmixed, high yielding planting seed are important in peanut production. Two kinds of peanuts mixed together are hard to sell. If the seed are mixed the whole crop will be mixed.

A high price paid for good seed may make more money than a low price paid for poor seed. The use of poor seed will materially reduce the value of the crop. A good stand cannot be gotten with poor seed, and peanuts cannot be satisfactorily replanted because the replants will not have time to mature before the regular planting is ready to dig. Figure 1 shows what happens to the stand when good and poor seed are planted.

The peanut, perhaps more than any other plant, responds to care in selection of seed. The seed should be saved only from mature plants and those having the greatest number of sound, mature pods. The part of the crop intended for seed should be thoroughly mature, and after digging should be

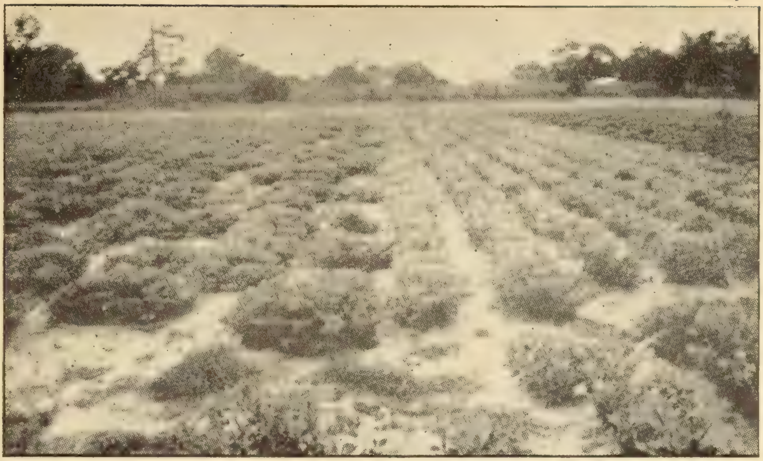

Figure 1.—Poor seed on the left. Good seed planted on the right.

allowed to cure until the foliage is perfectly dry before stacking. Being allowed to dry rapidly in this way, a much higher percentage of germination is usually obtained. From the seed saved in this way a few of the largest, heaviest pods should be selected to plant a seed patch for the next year. By following a system of seed selection the size nuts of any variety may be increased, resulting in a better price for the crop. Seed selection is one of the phases of peanut growing which has been seriously neglected. Germination tests should always be run. Germination tests may be made by putting the seed in moist cotton which should be kept at a temperature of 75° Fahrenheit.

All seed should be gone through, and all pops and immature seed removed. A good stand of peanuts is very essential toward getting a satisfactory yield. Many peanut failures are due to not having a stand on the land planted. About as much work is required to work a half stand as a perfect stand of peanuts.

References: Tom Houston Peanut Company Bulletin, "Peanuts, Culture and Marketing of the White Spanish Variety in the Southeastern States," pages 10 and 11, Second Edition 1931, Columbus, Georgia.

Virginia Agricultural Experiment Station Bulletin 218, "Peanut Culture," page 8, Blacksburg, Virginia, January 1918.

Seed Selection of White Spanish Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Orangeburg sandy clay.

Procedure and Conditions: An effort is made in this test to determine if there is an advantage in selecting peanut planting seed. Planting seed used in plot one were seed with only one nut to the pod, plot two was planted with ordinary picker run seed and plots three and four were planted with one and two year selection seed. The seed for the selection plots were taken from vines that were heavily fruited and only pods having two nuts to the pod were planted.

All peanuts in this test received 400 pounds of 0-8-4 per acre, basic slag was used as a source of phosphorus. Peanuts were planted in 30-inch rows and spaced 6 to 8 inches apart in the drill.

Results:

SEED SELECTION OF WHITE SPANISH PEANUTS

Kind of seed	Yield of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
All seed one nut to pod	750	700	725	1,200	550	875
Picker run (ordinary planting stock)	787	840	813	1,250	800	1,075
Seed selected one year	833	890	861	1,200	890	1,045
Seed selected two years	833	960	896	1,066	900	983

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

PREPARATION OF SEED FOR PLANTING

The preparation of planting seed has a direct bearing on stand and yield. The seed should be examined for mixture to be certain of planting only one variety, especially if the peanuts are to be harvested for the market. In removing seed mixtures, also pick out immature nuts, leaving only the well matured nuts for planting.

When the Spanish variety is used it is best to plant in the shell. A stand can be secured much quicker by soaking the peanuts, in the shell, over night, in water before planting. Shelled Spanish peanuts do not seem to germinate very well, resulting in uneven stands, which lowers the yield and in some cases the quality of peanuts produced. If the runner varieties of peanuts are planted it is necessary that the seed be shelled, and it is much better to hand shell them than with a machine. The hull of the runner varieties seem to be tougher and nearly water proof which necessitates shelling. The runner varieties can not be planted in the shell very well with a planter, due to the size.

The peanut growers of Southeast Alabama plant approximately 85% runner varieties. Due to this most of their peanuts are shelled for planting. The general practice is to shell peanut planting seed during the winter months when weather conditions prevent other farm work.

Very little experimental work has been conducted to show the effect of seed preparation on stand and yield of peanuts. Due to this fact a peanut grower should experiment with different methods of seed preparation and determine the most satisfactory method to use on a particular farm.

The Effect of Methods of Preparing Seed on Yields of Peanuts

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Substation No. 11 at Nacogdoches, Texas.

Period: One year.

Purpose: To compare the different methods of preparing seed for planting.

Soil: Orangeburg fine sandy loam.

Procedure and Conditions: Peanuts can be prepared for planting by hulling, by cracking the hulls, or they can be planted whole. In the eastern part of the State, which is heavily timbered, it is best to either crack or shell the peanuts before planting; otherwise a large part of the stand will be destroyed by birds while the plants are emerging from the soil. Breaking the pod into two pieces will give practically the same results as hulling. A one-year experiment at Substation No. 11, Nacogdoches, shows only a slight difference in the yields of nuts and forage between the cracked hull, and the whole hull, in the thirty-six-inch rows, while with the eighteen-inch rows, the same yields were obtained from both methods of preparing the seed.

Results:

A COMPARISON OF TWO METHODS OF PREPARING SEED. YIELDS ARE REPORTED AS BUSHELS OF NUTS AND TONS OF FORAGE

	36-inch Rows		18-inch Rows		Average	
	Nuts	Forage	Nuts	Forage	Nuts	Forage
Not hulled	34	1.57	37	1.53	35.5	1.55
Cracked hull	36	1.60	37	1.53	36.5	1.56

Reference: Texas Agricultural Experiment Station Bulletin 381, "Peanuts in Texas," pages 9 and 10, table 2, May 1928. College Station, Texas.

Peanut Seed Treatment

Conducted by: Georgia Agricultural Experiment Station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture.

Conducted at: Tifton, Georgia.

Period: 1940.

Purpose: To determine the effect of ceresan on the peanut seed prepared for planting by different methods.

Procedure and Conditions: In this test four types of seed were used. The seed were divided in half. One-half were treated with 2 percent Ceresan. Test plots were planted in 50-foot rows and 100 seed planted to each row.

This test has only been conducted for one year and the results may not be reliable for determining the value of seed types because of the variation in stand but results of this test may be used as an indication of what may be expected with the use of different type seed in the treatments indicated.

Results:

TREATED AND UNTREATED SPANISH PEANUT SEED

Type of seed and treatment	Germination	Plants in 50-ft. row at harvest	Av. 50-ft. row	Acre basis
	Percent	Number	Pounds	Pounds
Hand-shelled	82.2	81.2	4.56	1,589
Hand-shelled, ceresan-dusted	88.6	86.4	4.87	1,697
Machine-shelled	50.8	46.4	3.60	1,254
Machine-shelled, ceresan-dusted	79.8	68.2	4.63	1,614
Pegs	67.8	61.8	3.62	1,262
Pegs, ceresan-dusted	83.4	78.8	4.27	1,488
Not shelled	21.8	22.0	2.07	721
Not shelled, ceresan-dusted	29.2	27.4	2.47	861

Reference: Georgia Agricultural Experiment Station Annual Report, 1940-1941, page 104, table 58, Experiment, Georgia.

FERTILIZERS FOR PEANUTS

The success of any farmer depends a great deal on the economical production of the highest yields of crops or livestock. A large percent of the farms in Mississippi require the application of plant food in some form to produce crops of sufficient volume to be economical.

Peanuts are not different to other crops, in that plant food must be supplied if satisfactory yields are made. The response of peanuts to fertilization is not, however, as consistent as the response of other crops to fertilizers. The effect of the peanut on the soil is not clearly understood, especially if the peanuts are harvested. According to experimental work by the Alabama Experiment station results indicate that the greatest fertilizer needs of the years practically ruins the soil for production of crops. The peanut growers of Southeast Alabama say that peanuts should never be harvested on the same land two years in succession.

In some instances peanuts respond very little to the application of fertilizer, especially on very fertile soil or following a highly fertilized crop. Experiment station results indicate that the greatest fertilizer needs of the peanut are phosphorus, lime, and potash.

The experimental work with peanuts is very limited. A number of the tests have been conducted for a short period and the results may not be conclusive. In studying the information this fact should be considered.

The Effect of Various Fertilizers on Germination and Yield of Peanuts

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, Virginia.

Period: One year, 1931.

Purpose: To study the effect of the various elements of plant food on the yield of peanuts.

Soil: Onslow fine sandy loam. The top soil is dark gray sandy loam and the subsoil is a pale yellow sandy loam slightly heavier than the surface layer. The land is nearly flat and ditches are depended upon to carry off the surface water. In wet weather the soil water rises to within a few inches of the surface. This type of soil is not so well adapted to the growing of peanuts as is Norfolk sandy loam.

Procedure and Conditions: This experiment was conducted in a two-year rotation of peanuts and corn. The corn land was seeded to rye at the last cultivation, and the peanut land was seeded to crimson clover at the time of digging as cover and green manure crops.

The experiment was planned so that all plots receiving nitrogen received it at the rate of 10 pounds of ammonia to the acre; those receiving phosphoric acid received it at the rate of 40 pounds to the acre; and those receiving potash received it at the rate of 40 pounds to the acre. Gypsum was used where indicated at the rate of 160 pounds to the acre, which is approximately equivalent to the amount contained in 250 pounds of 16 percent superphosphate. When the materials were applied before planting, they were distributed in the row and bedded upon immediately. The seed were planted on the beds the following day. When used as top dressings, the fertilizers were applied as soon as practicable after the plants were up.

Results:

THE EFFECT OF VARIOUS FERTILIZERS ON GERMINATION AND YIELD OF PEANUTS FOR ONE YEAR, 1931

Plot No.	Material and time of application	Stand in 14 days	Final Stand	Yield of unshelled peanuts per acre
		Percent	Percent	Pounds
1	40 lbs. potash from kainit before planting	48	73	1200
2	40 lbs. potash from muriate before planting	85	90	1420
3	40 lbs. potash from sulphate before planting	88	91	1450
4	Check	91	95	920
5	40 lbs. potash from sulphate of potash-magnesia before planting	85	91	1360
6	40 lbs. potash from kainit top dressing	89	93	1400
7	40 lbs. potash from muriate top dressing	84	90	1250
8	Check	90	95	880
9	500 lbs. 2-8-8 before planting	62	81	1250
10	500 lbs. 2-8-2 before planting, 60 lbs. muriate potash top dressing	81	91	1320
11	143 lbs. cottonseed meal before planting	90	93	890
12	Check	90	95	850
13	250 lbs. superphosphate before planting	88	92	1300
14	250 lbs. superphosphate and 165 lbs. gypsum before planting	85	90	1180
15	165 lbs. gypsum before planting	83	92	960

Reference: Virginia Agricultural Experiment Station Bulletin 284, "Experiments with Lime, Fertilizers, and Varieties of Field Crops in the Cotton and Peanut Section of Virginia," pages 3, 12 and 13, table 6, Blacksburg, Virginia, May 1932.

Yields of Peanuts Show Response to Fertilization

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Farms of B. T. Clayton and E. H. Mosby in cooperation with J. B. McInnis, vocational agriculture teacher of Lauderdale High School, Lauderdale, Mississippi.

Period: 1939.

Purpose: To determine the response of peanuts to fertilizer.

Soil: B. T. Clayton farm—Norfolk loamy sand.
E. H. Mosby farm—Ruston loamy sand.

Procedure and Conditions: The soil on the B. T. Clayton farm will probably make 250 pounds of lint cotton with 300 pounds of 4-8-4 during an average year. The soil on the E. H. Mosby farm was very poor, having been discarded for other crops.

Results:

B. T. CLAYTON FARM—LAUDERDALE, MISSISSIPPI

Treatment	Yield in pounds peanuts per acre
400 pounds 8-8-4	967
400 pounds 4-8-4	789
400 pounds 0-8-4	1126
400 pounds 4-4-4	802
400 pounds 4-0-4	760
400 pounds 4-8-0	764
400 pounds 4-8-4 (P_2O_5 from basic slag)	1161
400 pounds 4-8-4 (top dressed with 400 pounds gypsum)	738
400 pounds gypsum (top dressed)	742
1250 pounds lime	900
No fertilizer	617

E. H. MOSBY FARM—LAUDERDALE, MISSISSIPPI

Treatment	Yield, pounds per acre
400 pounds 8-8-4	522
400 pounds 4-8-4	443
400 pounds 4-8-4 (P_2O_5 from basic slag)	677
400 pounds 0-8-4	524
400 pounds 4-4-4	433
400 pounds 4-0-4	457
400 pounds gypsum (top dressed)	469
No fertilizer	368

Reference: Mississippi Farm Research, Volume 2, Number 12, page 7, State College, Mississippi, December 1939.

Rates of Fertilizing Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Orangeburg sandy clay.

Procedure and Conditions: The field on which this test was conducted has been planted to cotton for several years. The cotton was fertilized with 200 to 400 pounds of a complete fertilizer and produced two-thirds of a bale to the acre in good years. In 1940 that part of the field not in peanuts made 110 pounds of lint cotton to the acre.

Peanuts were planted in 30-inch rows and were spaced 6 to 8 inches apart in the drill.

Results:

RATE OF FERTILIZING PEANUTS

Fertilizer treatment	Yield of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
200 lbs. 0-8-4	1,500	900	1,200	1,950	1,180	1,565
200 lbs. 4-8-4	1,525	1,410	1,467	2,037	1,360	1,198
400 lbs. 0-8-4	1,350	1,020	1,185	1,997	1,230	1,613
400 lbs. 4-8-4	1,375	1,530	1,452	2,385	1,740	2,062
600 lbs. 0-8-4	1,220	1,260	1,240	1,837	1,165	1,501
600 lbs. 4-8-4	1,407	1,255	1,331	2,237	1,868	2,052
800 lbs. 0-8-4	1,257	1,265	1,261	1,862	1,450	1,656
800 lbs. 4-8-4	1,320	1,020	1,170	2,250	2,165	2,207
Check	1,244	----	----	1,838	----	----

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Fertilizer Analysis Test with Spanish Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Orangeburg sandy clay.

Procedure and Conditions: These tests were conducted under extreme weather conditions having a tremendous amount of rain during the growing season. All plots in this test were replicated 4 times and received 400 pounds per acre of a different analysis as shown below. The peanuts were planted in 30-inch rows, spaced 6 to 8 inches apart in the drill and were planted on May 2.

The results show an average of two tests conducted on different farms.

Results:

FERTILIZER ANALYSIS TEST WITH SPANISH PEANUTS

Fertilizer treatment	Yield of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
4-8-0 basic slag source of phos.	1,165	1,191	1,173	1,575	1,486	1,530
4-8-4 basic slag source of phos.	1,681	949	1,315	1,677	1,062	1,369
0-8-0 basic slag source of phos.	1,060	1,067	1,063	1,102	1,433	1,267
0-8-4 basic slag source of phos.	1,090	1,291	1,190	1,235	1,540	1,387
0-8-8 basic slag source of phos.	1,517	1,246	1,381	1,401	1,640	1,520
4-4-0 basic slag source of phos.	1,561	1,200	1,380	1,592	1,522	1,557
4-4-4 basic slag source of phos.	1,637	1,137	1,387	2,186	1,237	1,711
4-4-4 acid phos. source of phos.	1,580	1,142	1,361	1,722	1,295	1,508
4-8-4 acid phos. source of phos.	1,653	1,062	1,357	1,921	1,531	1,226
Check	962	950	956	1,192	1,520	1,356

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Nitrate of Soda as a Side Dressing for Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Ruston loamy sand.

Procedure and Conditions: All plots in this test were fertilized with 400 pounds of basic slag and 50 pounds of muriate of potash at planting and side-dressed on the dates shown below with 100 pounds of nitrate of soda.

The land on which this test was conducted was planted to corn two years preceding this test. The yield of corn was from 7 to 10 bushels per acre.

Results:

NITRATE OF SODA AS A SIDE DRESSING FOR PEANUTS

Date of side dressing	Yield of nuts pounds per acre		
	1940	1941	Average
June 11	655	1,020	837
June 22	642	930	786
July 6	630	900	735
Check	430	610	520

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Fertilizer Formula Test with Peanuts

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1928-1937.

Purpose: To determine the best fertilizer formula for peanuts.

Soil: Tifton sandy loam.

Procedure and Conditions: This test was run on plots 1/40 acres in size. The rows were 3.3 feet wide and the plants were spaced 6 inches. This spacing is wider than recommended.

The fertilizer was stirred in the furrow at the time of planting. The average planting date was April 10. Spanish peanuts were used. The test was run in duplicate.

Where peanuts follow a crop that has received little or no fertilizer, an application of 200 to 300 pounds of a complete fertilizer that is low in nitrogen should give profitable increases in yield. A light application of fertilizer also reduces the drain on plant food elements of the soil often evident where peanuts are harvested for market. Where peanuts are planted in a rotation with well fertilized crops, good yields should be obtained without the use of fertilizer. In that case fertilizer is applied to crops more responsive to fertilization and peanuts are followed to use residual plant food.

Other data show that most of the phosphorus, much of the potash, but little of the nitrogen remain in the soil after a well fertilized cotton crop. The peanut, being a legume, draws most of the nitrogen from the air, but draws upon the soil for phosphoric acid, potash, and lime.

Results:

FERTILIZER FORMULA TEST WITH PEANUTS

400 pounds of fertilizer per acre applied previous to planting

Formula	Yield in unhulled nuts in pounds per acre										Average
	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1928-37
Phosphoric acid series											
2-0-4	1065	835	565	1280	1323	2095	1377	1577	1237	1699	1305
2-6-4	1215	710	605	1370	1535	2165	1392	1467	1333	1710	1350
2-8-4	1330	910	640	1350	1419	1985	1340	1460	1265	1672	1337
2-10-4	1260	790	730	1390	1510	2040	1309	1572	1245	1725	1357
2-12-4	1330	625	560	1410	1442	2075	1267	1482	1290	1720	1320
2-16-4	1370	585	520	1390	1410	2050	1287	1558	1230	1742	1314
Ammonia series											
0-10-4	1195	790	612	1220	1341	1955	1260	1375	1225	1733	1271
2-10-4	1015	855	645	1410	1429	2095	1280	1487	1310	1745	1327
4-10-4	1060	915	660	1490	1561	2040	1373	1538	1255	1588	1348
6-10-4	1185	980	630	1455	1620	2075	1357	1600	1290	1865	1406
8-10-4	1165	910	650	1490	1544	2180	1369	1652	1385	1888	1422
Potash series											
2-10-0	1085	725	565	1330	1399	1775	1303	1502	1300	1683	1267
2-10-2	1140	705	622	1530	1501	1955	1330	1462	1298	1800	1316
2-10-4	1290	825	625	1310	1489	2065	1333	1553	1290	1782	1356
2-10-6	1400	895	672	1320	1465	2265	1372	1625	1280	1792	1409
2-10-8	1315	740	745	1370	1426	2420	1346	1590	1250	1854	1406
No fertilizer	1025	668	484	1125	1066	1680	1260	1261	1210	1555	1133

Reference: Annual Reports Georgia Coastal Plain Experiment Station, Tifton, Georgia.

Effect of Fertilizers on Yield of Peanuts

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, Virginia.

Period: 1914-1921:

Purpose: To determine the effect of fertilizers on yield of peanuts.

Procedure and Conditions: In the experiments here reported peanuts have received no fertilizer as a direct application, hence only the residual effect of that used for cotton the previous year are shown. It is believed that when other crops in the rotation receive applications of fertilizer it is necessary to apply only phosphorus to the peanut crop. Our experimental results show that large quantities of nitrogen used on a fairly fertile soil always produce a poor quality of peanuts. At the same time the yield is not materially increased. The use of this element causes the vines to grow too rapidly and consequently the axils, where the flowers are formed are too far apart. It also causes a profuse growth of vine and a corresponding lateness of maturity. When the vines are killed by frost there are always a number of immature nuts or "saps" which are of a dark color and require much longer to dry than fully matured nuts. These results are not applicable under all conditions, however. On light sandy soils, which are deficient in organic matter, an application of nitrogen often pays, especially when used in connection with phosphoric acid. When nitrogen is used it should always be derived from some organic material, cottonseed meal probably being the best source of nitrogen.

Phosphorus seems to give better results than any other element as a peanut fertilizer. It hastens maturity and usually produces nuts with firm, well-filled white hulls, which are the qualities so much desired by the cleaner.

Potash, like nitrogen, produces dark-hulled nuts of a poor quality, especially when used on the darker soils. This element gives good results on the sandier type of soils.

In order to fertilize peanuts judiciously it is necessary to study the condition of the particular soil and supply those elements which seem to be lacking. If the soil will produce a fair growth of vines, the use of nitrogen and potash can be eliminated. If the soil is light and sandy and lacking in organic matter, a complete fertilizer will pay. A complete fertilizer analyzing 2 percent nitrogen, 8 percent phosphoric acid, and 4 percent potash with all of the nitrogen from an organic source is recommended for general use on thin, sandy soils. This may be used at rates varying from 300 pounds to 500 pounds to the acre, depending upon the fertility of the soil.

Superphosphate at rates varying from 300 to 500 pounds to the acre to hasten maturity is the only fertilizer recommended for this crop on heavy, fertile soils.

Results:

EFFECTS OF FERTILIZERS ON PEANUTS

Plot No.	Materials used in pounds per acre	Yield in pounds of peanuts per acre								Av. Yield 1914-1921
		1914	1915	1916	1917	1918	1919	1920	1921	
1	240 dried blood	1540	1180	1480	560	1080	1300	600	1600	1167.5
2	500 acid phosphate	1360	1680	1660	660	1160	2080	720	1520	1355.0
3	200 muriate of potash	1600	1160	1600	680	1160	1540	1000	2000	1342.5
4	No fertilizer	1400	700	1820	500	720	1780	800	2100	1227.5
5	(240 dried blood (200 muriate of pot.	1500	1400	1720	640	1240	1580	1200	2260	1442.5
6	(500 acid phosphate (200 muriate of pot.	1760	1260	1900	700	1120	1720	1280	2160	1387.5
7	(240 dried blood (500 acid phosphate	2400	1200	1960	540	860	2400	1000	2000	1545.0
8	(240 dried blood (200 muriate of pot. (500 acid phosphate	1240	1480	2060	580	980	2000	1440	2300	1510.0
9	(480 dried blood (400 muriate of pot. (1000 acid phosphate	2920	1080	1500	560	1260	1840	1300	2200	1582.5
10	No fertilizer	1160	1540	2760	500	860	2420	840	1600	1460.0
11	600 fish scrap	820	1620	2440	640	820	2220	1040	1520	1390.0
12	800 cottonseed meal	720	1560	1480	740	1060	1720	1200	1760	1280.0
13	600 4-8-4 fertilizer	820	1240	1500	580	1200	1480	1320	1180	1165.0

Reference: Virginia Agricultural Experiment Station Bulletin 229, "Experiments with Cotton and Peanuts," pages 14 and 15, table 4, Blacksburg, Virginia, October 1922.

Rates of Nitrogen, Phosphorus and Potash for Peanuts

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, Virginia.

Period: 1936-1941.

Purpose: To compare the different rates of nitrogen, phosphorus and potash on the yield of peanuts.

Procedure and Conditions: This series of tests was begun in 1936. The nitrogen in these tests was derived from one-third cottonseed meal and two-thirds urea. The phosphorus was derived from 20% superphosphate and the potash was derived from 50% muriate.

Results:

RATES OF NITROGEN, PHOSPHORUS AND POTASH FOR PEANUTS

NITROGEN SERIES

All plots in this series except No. 2 get 60 lbs. phosphoric acid and 60 lbs. potash

Plot No.		1936	1937	1938	1939	1940	1941	6 yr. av.
1	No nitrogen	1320	1520	1360	2200	2280	1460	1690
2	No fertilizer	1080	1720	1160	2340	2260	1080	1607
3	16 lbs. nitrogen	1480	2040	1000	2380	2400	1300	1766
4	24 lbs. nitrogen	1440	1920	1000	2280	2280	1040	1660
5	32 lbs. nitrogen	1280	1600	980	2360	2220	1020	1577
6	40 lbs. nitrogen	1360	1680	980	2140	2080	1180	1570
7	56 lbs. nitrogen	1320	1960	920	2220	2180	1400	1666
8	72 lbs. nitrogen	1320	2000	1000	1980	2280	1340	1653
9	112 lbs. nitrogen	1380	1920	880	2180	2260	1220	1623

(Continued)

RATES OF NITROGEN, PHOSPHORUS AND POTASH FOR PEANUTS—Continued

PHOSPHORUS SERIES

All plots in this series except No. 14, get 60 lbs. nitrogen and 60 lbs. potash

Plot No.		1936	1937	1938	1939	1940	1941	6-yr. av.
10	No phosphoric acid	1200	1240	1100	2280	2020	1160	1500
11	16 lbs. phos. acid	1560	1200	1320	2620	2300	1100	1707
12	32 lbs. phos. acid	1560	1800	1400	2760	2380	1240	1875
13	48 lbs. phos. acid	1680	1920	1200	2600	2300	1020	1787
14	No fertilizer	1200	1480	1080	2120	2000	860	1457
15	64 lbs. phos. acid	1360	1640	1220	2380	2120	1080	1633
16	88 lbs. phos. acid	1360	1720	1160	2080	2240	1020	1597
17	112 lbs. phos. acid	1400	1600	1180	2020	2200	1160	1593
18	144 lbs. phos. acid	1280	1280	1280	2100	2140	1420	1583

POTASH SERIES

All plots in this series except No. 26 get 60 lbs. nitrogen and 60 lbs. phosphoric acid

Plot No.		1936	1937	1938	1939	1940	1941	6-yr. av.
19	No potash	1200	1320	1280	2080	1600	1200	1447
20	25 lbs. potash	1040	1360	1380	2120	1860	1340	1517
21	50 lbs. potash	1200	1520	1440	2140	1980	1520	1633
22	75 lbs. potash	1240	1480	1580	1900	2060	1680	1657
23	100 lbs. potash	1320	1760	1560	2000	2100	1500	1707
24	150 lbs. potash	1200	1920	1320	1760	1840	1460	1583
25	200 lbs. potash	1200	1600	1260	1740	2140	1100	1490
26	No fertilizer	880	1240	980	1060	1660	1120	1157
27	250 lbs. potash	1120	1600	1360	1580	2000	1000	1277

Reference: Unpublished data. Report of Virginia Agricultural Experiment Station at the Peanut Fertilizer Conference in Atlanta, Georgia, March 11, 1942.

The Effect of Fertilizer on Yield of Spanish Peanuts

Conducted by: Florida Agricultural Experiment Station.

Conducted at: The farm of C. W. Williams, north of Marianna, Florida.

Period: 1931.

Purpose: To determine the effect of various fertilizers on yield of peanuts.

Soil: Norfolk sandy loam.

Procedure and Conditions: There were five treatments in the experiment and each was replicated seven times, using 1/10 acre plots. The treatments, the yield of nuts and hay from the various treatments and the grade of the nuts reported by officials of the Alabama-Florida Cooperative Peanut Association are given below.

Results:

FERTILIZER EXPERIMENTS WITH SPANISH PEANUTS

Treatment* (N-P-K)	Yield bu. per acre	Bu. increase due to fertilizers	Grade U.S. Standard	Acre yields hay pounds	Increase due to fertilizers pounds
No fertilizer	31.3	—	No. 1	945	—
3-10-0	38.3	7.0	No. 1	1,032	87
3-10-4	40.8	9.5	No. 1	1,181	236
3-10-8	40.2	8.9	No. 1	1,224	279
3-10-12	39.5	8.2	No. 2	1,271	326

*Fertilizer used at the rate of 400 pounds per acre.

Reference: Florida Agricultural Experiment Station 1932, Annual Report, pages 28 and 29, table 3, Gainesville, Florida, June 30, 1932.

Rates of Fertilizer (NPK) Application and Lime Test

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1931-1937.

Purpose: To determine the best rate of fertilizer to apply to peanuts.

Soil: Tifton sandy loam.

Procedure and Conditions: In this test peanuts followed a general rotation in which other crops received 200 to 600 pounds of complete fertilizer. The rates-of-application test was divided into 3 parts, one receiving no limestone, one 500 pounds of limestone and another receiving 1,000 pounds of limestone. Lime has not given profitable returns on well drained Tifton sandy loam soils.

Results:

RATES OF FERTILIZER (NPK) APPLICATION AND LIME TEST
Yield of unhulled nuts in pounds per acre

Year	No fertilizer	200 lbs. 2-10-4	400 lbs. 2-10-4	600 lbs. 2-10-4	800 lbs. 2-10-4
No limestone					
1931	1340	1310	1300	1370	1340
1932	1436	1556	1615	1692	1671
1933	1510	1680	1805	1710	1505
1934	1444	1506	1473	1475	1403
1935	640	702	761	916	954
1936	1195	1250	1343	1331	1295
1937	1260	1440	1560	1710	1730
Average yield	1361	1349	1408	1458	1414
500 lbs. limestone					
1931	1080	1180	1320	1200	1200
1932	1396	1528	1568	1704	1730
1933	1470	1600	1660	1610	1690
1934	1352	1292	1408	1418	1490
1935	770	930	1104	1160	1100
1936	1070	1160	1164	1220	1260
1937	1480	1660	1756	1840	1902
Average yield	1230	1336	1426	1450	1482
1000 lbs. limestone					
1931	990	1000	1140	1160	1180
1932	1436	1594	1774	1796	1832
1933	1460	1470	1650	1680	1490
1934	1482	1492	1546	1542	1592
1935	794	928	1040	1118	1086
1936	1046	1170	1155	1222	1246
1937	1330	1520	1624	1820	1800
Average yield	1220	1310	1418	1477	1461

Reference: Georgia Coastal Plain Experiment Station Eighteenth Annual Report, 1937-1938, page 27, table 15, July 1938, Tifton, Georgia.

Yield Peanuts from Soil Types Receiving Different Fertilizers—1938-39

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Edgecombe and Bertie Counties, North Carolina.

Period: 1938-1939.

Purpose: To determine the value of different complete fertilizers and fertilizer materials in increasing peanut yields on different soil types.

Soil: Norfolk very fine sandy loam and Ruston loam soil.

Procedure and Conditions: The tests were conducted on several selected farms in each county using different fertilizer treatments, each treatment being replicated six times in the same field. The fertilizer was applied at planting time in the row. The supplement treatment which included lime and gypsum was applied (1) Dolomitic lime applied in the row at planting time and (2) gypsum applied on the foliage at blooming time.

Results:

YIELD OF PEANUTS FROM SOIL TYPES RECEIVING DIFFERENT FERTILIZERS

Rate	Fertilizer	Supplement		Norfolk very fine sandy loam Edgecombe Co. yield lbs.		Ruston loam soil Bertie County yield lbs.	
	Treatment	Rate	Treatment	1938	1939	1938	1939
25	Muriate of potash			1610.4	1540.0	598.4	1284.8
75	Muriate of potash			1522.4	1540.0	677.6	1557.6
200	0-12-6			1284.8	1742.4	563.2	1460.8
200	3-12-6			1434.4	1452.0	704.0	1425.6
450	Superphosphate			1284.8	1425.6	440.0	1443.2
200	0-12-6	400	Lime[1]	1381.6	1821.6	704.0	1416.8
200	0-12-6	400	Gypsum[2]	1557.6	1460.8	704.0	1548.8
		400	Lime[1]	1267.2	1786.4	554.4	1460.8
		400	Gypsum[2]	1293.6	1566.4	668.8	1302.4
		400	Lime[1])				
		400	Gypsum[2])	1267.6	1768.8	651.2	1504.8
Average yield of check plot				1170.4	1592.8	598.4	1408.0

[1] Applied in row at planting time. [2] Applied on foliage at blooming time.

Reference: North Carolina Agricultural Experiment Station Agronomy Information Circular 123, "Soil Fertility Investigations with Peanuts," January 1940, Raleigh, North Carolina.

Peanut Yields on Soil Types Receiving Different Fertilizer Treatments

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Bladen, Martin, Perquimans and Hertford Counties, North Carolina.

Period: 1939.

Purpose: To determine the value of different complete fertilizers and fertilizer materials in increasing peanut yields on different soil types.

Soil: Ruston sandy loam, Portsmouth sandy loam. Norfolk sandy loam and Coxville very fine sandy loam.

Procedure and Conditions: Several farms were selected in the following counties: Bladen, Martin, Perquimans and Hertford, on which to conduct fertilizer experiments with peanuts. The pH reading was taken on each field used in these tests.

The fertilizer treatment used in these tests was as follows: (1) No fertilizer with gypsum in the row and on the foliage, (2) muriate of potash 25 pounds per acre with no gypsum, 300 pounds in the row and 300 pounds on foliage, (3) superphosphate with no gypsum, 300 pounds gypsum in the row and 300 pounds on the foliage, (4) 0-12-6 with no gypsum, 300 pounds gypsum in row and 300 pounds on foliage, and (5) 3-12-6 with no gypsum, 300 pounds gypsum in row and 300 pounds on foliage.

Results:

PEANUT YIELDS ON SOIL TYPES RECEIVING DIFFERENT FERTILILZER TREATMENTS

Plot No.	Fertilizer		Gypsum		Yield per acre			
	Rate	Treatment	Rate	Application	Ruston sandy loam pH 4.5-5.2 lbs.	Portsmouth sandy loam pH 4.4-5.5 lbs.	Norfolk sandy loam pH 5.0-5.8 lbs.	Coxville very fiine sandy loam pH 5.4-6.5 lbs.
1		None	------	------	572.0	880.0	2129.6	1126.4
2		None	300	In row	440.0	1180.0	2120.8	1240.8
3		None	300	On fol.	1293.6	739.2	2279.2	1117.6
4	25	Mur. of pot.	------	------	1311.2	1258.4	1865.6	1214.4
5	25	Mur. of pot.	300	In row	1003.2	1201.6	1592.8	1328.8
6	25	Mur. of pot.	300	On fol.	1452.0	1188.0	1997.6	1390.4
7	150	Superphos.	------	------	950.4	1188.0	2455.2	869.4
8	150	Superphos.	300	In row	1408.0	906.4	2120.8	1047.2
9	150	Superphos.	300	On fol.	976.8	1117.6	1900.8	1434.4
10	200	0-12-6	------	------	924.0	1452.0	2244.0	1196.8
11	200	0-12-6	300	In row	1320.0	1003.2	2261.6	1223.2
12	200	0-12-6	300	On fol.	1592.8	1126.4	2156.0	1020.8
13	200	3-12-6	------	------	976.8	871.2	2464.0	1399.2
14	200	3-12-6	300	In row	1311.2	1161.6	2252.8	968.0
15	200	3-12-6	300	On fol.	1180.8	1619.2	2499.2	1496.0

Reference: North Carolina Agricultural Experiment Station Agronomy Information Circular 123, "Soil Fertility Investigations with Peanuts," January 1940, Raleigh, North Carolina.

Effects of Various Forms of Lime on Yield of Peanuts

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, Virginia.

Period: 8 years—1914-1921.

Purpose: To determine the effect of various forms of lime fertilizer on yield of peanuts.

Procedure and Conditions: Results obtained from the use of lime under peanuts seem to indicate that the quality is affected much more than the quantity. This is evidenced by a whiter, firmer hull and an increase in weight per bushel.

Ground shells when used at the rate of 2 tons per acre gave practically the same results as one ton of burnt shells, while 4 tons of ground shells did not do so well as 2 tons of burnt shells. Contrary to expectations the heavy application of ground shells produced a much more harmful effect than half the amount of burnt shells. Plots receiving 4 tons of ground shells seem ruined for a time at least for growing any crop. This condition was much more evident after the second application four years from the time the first application was made.

The yield where land plaster was used was as good as that on the lime plots and the quality probably averaged a little better. However, crimson clover does not do well on the plot to which land plaster was applied.

The yield on plots receiving acid phosphate, bonemeal and basic slag was good, but the quality of peanuts from the acid phosphate plot was better than that of the other two.

Plots receiving nitrate of soda and potash in addition to lime produced a large number of dark-hulled nuts so late in maturing that they could not be harvested along with the other plots and the vines were killed by frost before maturity, causing the production of a large percent of immature peanuts of poor quality.

Results:

THE EFFECTS OF LIME ON THE YIELD OF PEANUTS

Plot No.	Materials used in pounds per acre	Yield in pounds of peanuts per acre 1914	1915	1916	1917	1918	1919	1920	1921	Av.yield 1914-1921
1	2000 burnt shells	1600	1260	2000	700	800	1100	1480	1620	1320.00
2	4000 ground shells	1440	1300	2240	720	1280	1020	500	1440	1242.50
3	500 land plaster	1400	1180	1600	640	1560	1240	1060	1720	1300.00
4	No lime	900	760	1500	600	1360	1380	900	1400	1100.00
5	4000 burnt shells	1700	1300	1900	640	1200	960	680	1280	1207.50
6	8000 ground shells	1200	840	1620	400	840	620	280	620	802.50
7	500 basic slag	1460	940	2200	760	1280	1660	900	1920	1390.00
8	500 acid phos.	900	1260	1400	720	1380	1750	960	1900	1283.75
9	500 bone meal	2000	980	1900	620	1000	1480	1000	1940	1365.00
10	No lime	1800	900	1620	460	800	1720	780	2400	1310.00
11	(2000 burnt shells (200 nit. of soda	3200	1160	1680	820	920	1920	1020	2440	1650.00
12	(2000 burnt shells (200 mur. of pot.	800	1020	1460	760	1000	1720	1200	2200	1270.00
13	(2000 burnt shells (200 sulph. of pot.	1100	1080	1340	600	1060	1200	1240	1540	1145.00

Reference: Virginia Agricultural Experiment Station Bulletin 229, "Experiments with Cotton and Peanuts," pages 15 and 16, table 5, Blacksburg, Virginia, October 1922.

The Effects of Ground Oyster Shells Applied at Intervals of 3 Years on Yield of Cotton, Peanuts, Corn, Soybean Hay and Irish Potatoes

Conducted by: Virginia Agricultural Experiment Station.
Conducted at: Holland in Nansemond County, Virginia.
Period: 1923-31.

Purpose: To determine the most economical rates of liming for the more important crops grown in the section.

Soil: Onslow fine sandy loam. The top soil is dark gray sandy loam and the subsoil is a pale yellow sandy loam slightly heavier than the surface layer. The land is nearly flat and ditches are depended upon to carry off the surface water. In wet weather the soil water rises to within a few inches of the surface. This type of soil is not so well adapted to the growing of peanuts of as good quality as is Norfolk sandy loam.

Procedure and Conditions: A five-year rotation of cotton, corn, peanuts, soybeans and Irish potatoes was established. The land was kept covered with a growing crop at all times. Cotton was followed by a cover crop of crimson clover, corn by wheat, peanuts by vetch, soybeans by rye, and potatoes by soybeans, which were plowed down in the fall and followed by oats as a winter cover crop. Nothing was removed from the land except the main crops of the rotation, namely, cotton, peanuts, corn, soybean hay and potatoes. All cover crops were turned under immediately preceding the planting of the next crop in the rotation, thus maintaining an abundance of organic matter in the soil. The corn was fertilized with 500 pounds of 4-12-4, the cotton with 600 pounds of 4-12-6 and the potatoes with 1,000 pounds of 7-6-5 fertilizer to the acre. Other crops in the rotation received no fertilizer.

The area used in this rotation was subdivided into eight plots which were treated as indicated below. Plot 1 received no lime and plots 2 to 8, inclusive, received the quantities of lime stated in the table in the form of ground oyster shells. The lime was applied by broadcasting every third year and it was worked into the soil while preparing the seedbed for the next crop.

Results:

THE EFFECTS OF GROUND OYSTER SHELLS APPLIED AT INTERVALS OF THREE YEARS ON THE YIELD OF COTTON, PEANUTS, CORN, SOYBEAN HAY AND IRISH POTATOES

Plot No.	Amount of lime applied per acre	Yield of seed cotton per acre 9-yr. Av. 1923-1931	Yield of unshelled peanuts per acre 9-yr. Av. 1923-1931	Yield of corn per acre 9-yr. Av. 1923-1931	Yield of field cured soybean per acre 5-yr. Av. 1926-1930	Yield of I. potatoes per acre 7-yr. Av. 1925-1931
	Pounds	Pounds	Pounds	Bushels	Pounds	Bushels
1	No lime	950	1100	52.2	5150	85.5
2	600	1000	1250	53.6	5300	87.5
3	900	1050	1350	55.7	5850	94.2
4	1200	1050	1300	59.3	5800	92.5
5	1500	1100	1350	60.0	6050	100.8
6	1800	1050	1450	63.6	5950	102.5
7	2100	1100	1300	58.6	5950	103.3
8	2400	1100	1200	56.4	6000	97.5

Reference: Virginia Agricultural Experiment Station Bulletin 284, "Experiments with Lime, Fertilizers and Varieties of Field Crops in the Cotton and Peanut Section of Virginia," pages 3 and 4, table 1, Blacksburg, Virginia, May 1932.

Comparison of Ground Oyster Shells and Dolomitic Limestone as Sources of Lime

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, in Nosemond County, Virginia.

Period: 1926-1931.

Purpose: To compare ground oyster shells and dolomitic limestone as sources of lime.

Soil: Onslow fine sandy loam. The top soil is dark gray sandy loam and the subsoil is a pale yellow sandy loam slightly heavier than the surface layer. The land is nearly flat and ditches are depended upon to carry off the surface water. In wet weather the soil water rises to within a few inches of the surface. This type of soil is not so well adapted to the growing of peanuts of as good quality as is Norfolk sandy loam.

Procedure and Conditions: A rotation was established consisting of cotton, corn and peanuts with Abruzzi rye following corn and crimson clover following cotton as cover and green manure crops. The corn received an annual application of 400 pounds of 2-8-4 fertilizer to the acre at planting time and 150 pounds of nitrate of soda to the acre as side dressings. The cotton received 600 pounds of 4-8-6 fertilizer at planting time. The peanut crop was not fertilized. The area was subdivided into five plots and lime was applied as indicated in the table. The ground oyster shell used in this test contained approximately 90 per cent of calcium carbonate and the dolomitic limestone contained approximately 50 percent of calcium carbonate and 40 per cent of magnesium carbonate. The first application of lime was made at the beginning of the experiment in 1926 and the second application in 1930.

Results:

A COMPARISON OF THE EFFECT OF GROUND OYSTER SHELLS AND DOLOMITIC LIMESTONE AND THE YIELDS OF COTTON, CORN AND PEANUTS, SIX-YEAR AVERAGE, 1926-1931

Plot No.	Rate of application per acre	Seed Cotton		Corn		Unshell. P.		Total Val. per A 6-yr. Av.
		Yield per acre	Value	Yield per acre	Value	Yield per acre	Value	
		lbs.	dol.	lbs.	dol.	lbs.	dol.	dol.
1	1 ton ground oyster shells	975	39.00	41.5	31.13	1185	47.40	235.06
2	1 ton dolomitic limestone	885	35.40	43.1	32.33	1185	47.40	230.26
3	No lime	825	33.00	41.8	31.35	1020	40.80	210.30
4	2 tons ground oyster shells	855	34.20	48.2	36.15	960	38.40	217.50
5	2 tons dolomitic limestone	840	33.60	47.5	35.63	930	37.20	214.86

Corn was valued at 75c a bushel and cotton and peanuts at 4 cents a pound. Ground oyster shells delivered at Holland cost approximately $6.00 a ton and dolomitic limestone $3.00 a ton. Therefore, the cost of oyster shells per acre per year was $1.50 and the cost of dolomitic limestone 75c per acre per year where the 1-ton applications were used and twice these amounts where the 2-ton applications were used.

Reference: Virginia Agricultural Experiment Station Bulletin 284, "Experiment with Lime, Fertilizers and Varieties of Field Crops in the Cotton and Peanut Section of Virginia," pages 6 and 7, table 3, Blacksburg, Virginia, May 1932.

PLANTING

As stated under land preparation, most of the peanut growers of Southeast Alabama bed their peanut land with a middlebuster about two weeks before planting.

When they are ready to plant, if fertilizer is used, a straight shovel is used on the distributor to open the bed. They try to get the furrow open to a level of the middlebuster furrow. If the distributor is not used, a straight shovel on a Georgia stock is used to open the furrow. This method is always used with the runner varieties. Sometimes with the Spanish peanuts the land is only flat broken and is layed off with the fertilizer distributor, or with the Georgia stock using a short straight shovel. The peanuts are planted with a planter, mostly Cole planters, in this furrow.

The usual spacing practice for runner varieties of peanuts is 30″ to 36″ rows spaced from 8″ to 14″ in the drill. To plant with this spacing from 17 to 25 pounds of shelled peanuts are required per acre. Spanish peanuts are planted in 24″ to 30″ rows and spaced from 6″ to 10″ in the drill, requiring 25 pounds to 30 pounds peanuts per acre.

There peanuts are planted immediately following cotton which is usually from the 1st to 15th of April. The weather should be warm and settled before planting peanuts. By planting this way there seems to be very little conflict in cultivating the two crops.

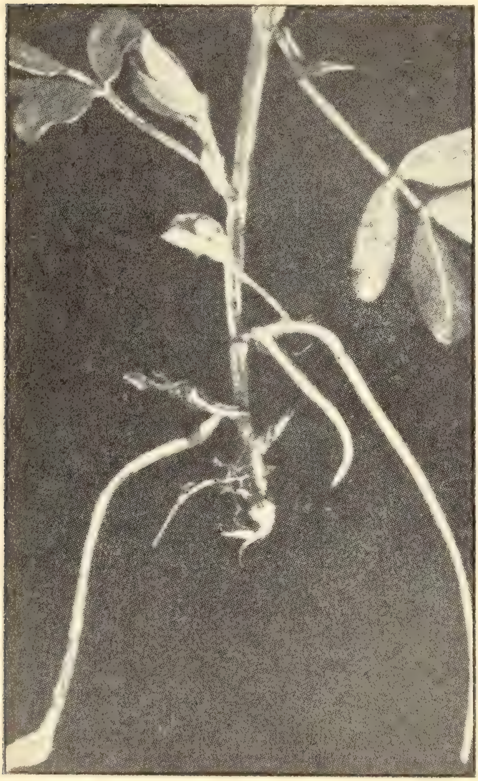

Figure 2.—Peanut flower and the pegs that form pods.

When Spanish peanuts are planted in 24-inch rows, the vines of one row will lean against the vines of the next row, thus shading the middles and helping to control the grass. Peanut plants produce many blooms. These blooms are borne at the joints where the leaves are attached to the stems and as soon as pollination takes place the bloom fades and the peg or stem elongates and goes into the ground where the pod develops as in figure 2. The first blooms appear in the end of link near the main stalk as illustrated in figure 3. The peanuts on the stems or pegs that form on the limbs or vines near the main stalk have been forming a long time before the vine is old enough to put out these stems. When the peanuts are mature they must be dug. Spanish peanuts will sprout if left in the ground too long after they have matured. Hence, if the vines are in wide rows they cannot hold each other up but lie down on the ground as illustrated in figure 4.

This gives the pegs a chance to go into the ground. But they have not time to make anything but an empty shell, called a pop. Part of the strength of the vine has been used to make these pops, which have no value. If this wasted plant food had gone to the peanuts first formed, there would have been more kernels and heavier ones. The peanut grower should be interested in getting the largest number of peanuts matured at the same time, especially if they are to be harvested for sale.

There are many living bacteria in the ground that are necessary to plant life. Some of these are easily killed by heat. Close rows that shade the middles help keep the ground cool. This enables a great many bacteria to live and do their work whereas they might die if exposed to the sunheated earth between wide rows.

Every farmer should experiment with his peanuts. Try some in different width rows and watch the results. The close rows will require more careful work.

It seems certain that close rows make more peanuts. At the same time they will require more work. Hence the 24-inch rows seem to be the width that will produce the most peanuts without making the work too inconvenient.

In some instances where peanuts are produced for hogs it is desirable for the vines of the plant to contact the ground to give the pegs on the vines a chance to develop nuts, as it is not necessary for as many nuts to mature at the same time. In some instances with the runner varieties a light roller is run over the vines after the final cultivation to flatten the vines on the ground to enable the pegs to reach the ground in order that nuts may be formed.

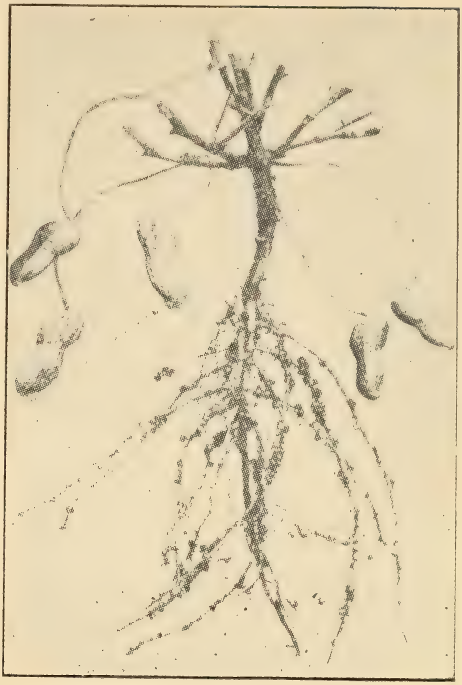

Figure 3.—Peanuts forming on limbs near surface of ground.

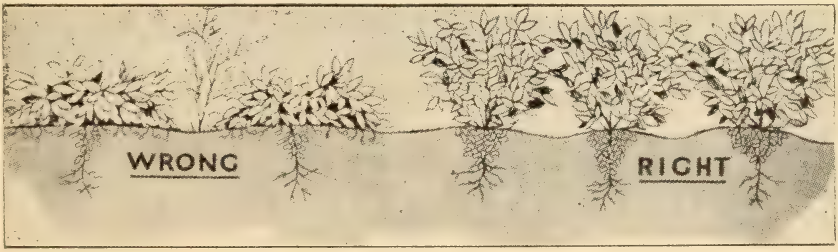

Figure 4.—Close rows shade middles and kill the grass. Upright vines make peanut kernels and not pops.

Dates of Planting Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-41.

Procedure and Conditions: All plots in this test were fertilized with 400 pounds of 0-8-4 per acre using basic slag as a source of phosphorus. Peanuts were planted in 30-inch rows and were planted 6 to 8 inches apart in the drill. White Spanish peanuts were used in this test.

Results:

DATES OF PLANTING PEANUTS

Fertilizer treatment	Yields of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
April 15	1,550	920	1,335	2,137	860	1,498
May 15	1,200	860	1,030	1,675	840	1,257
June 15	1,356	610	983	1,256	740	1,083

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Effect of Spacing on Yield

Conducted by Alabama Agricultural Experiment Station.

18 inch rows, with seed 4 inches in the drill produced 59.5 bushels per acre
24 inch rows, with seed 4 inches in the drill produced 52.7 bushels per acre
30 inch rows, with seed 4 inches in the drill produced 43.6 bushels per acre
36 inch rows, with seed 4 inches in the drill produced 43.3 bushels per acre

18 inch rows, with seed 8 inches in the drill produced 44.1 bushels per acre
24 inch rows, with seed 8 inches in the drill produced 39.0 bushels per acre
30 inch rows, with seed 8 inches in the drill produced 38.2 bushels per acre
36 inch rows, with seed 8 inches in the drill produced 27.1 bushels per acre

18 inch rows, with seed 12 inches in the drill produced 47.9 bushels per acre
24 inch rows, with seed 12 inches in the drill produced 38.6 bushels per acre
30 inch rows, with seed 12 inches in the drill produced 33.4 bushels per acre

References: Tom Huston Peanut Company Bulletin, "Peanuts, Culture and Marketing of the White Spanish Variety in the Southeastern States," pages 10 and 11, Second Edition 1931, Columbus, Georgia.

Virginia Agricultural Experiment Station Bulletin 217, "Peanut Culture," page 8, Blacksburg, Virginia, January 1918.

Farmers surveyed in Southeast Alabama.

Spacing Spanish Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Ruston loamy sand.

Procedure and Conditions: This test was conducted under extremely unfavorable weather conditions due to excessive amounts of rainfall during the growing season. The unfavorable weather may have affected the results of the test and this fact should be kept in mind in studying the results. This test was replicated 4 times and all plots were fertilized at the rate of 400 pounds of 0-8-4 fertilizer per acre using basic slag as the source of phosphorus. This test was planted on May 7.

Results:

SPACING WHITE SPANISH PEANUTS

Spacing	Yield of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
Rows 24 inches, 6 inches in drill	1,375	1,620	1,497	1,555	1,450	1,502
Rows 24 inches, 12 inches in drill	1,267	1,120	1.193	1,362	1,325	1,343
Rows 24 inches, 18 inches in drill	1,082	980	1,031	1,487	1,120	1,304
Rows 30 inches, 6 inches in drill	1,137	1,180	1,158	1,337	1,300	1,318
Rows 30 inches, 12 inches in drill	926	880	903	1,090	1,500	1,295
Rows 30 inches, 18 inches in drill	710	780	745	940	850	895
Rows 36 inches, 6 inches in drill	507	680	593	775	725	750
Rows 36 inches, 12 inches in drill	445	550	497	575	675	625
Rows 36 inches, 18 inches in drill	400	460	430	487	450	468

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Spacing of Runner Peanuts

Conducted by: Mississippi Agricultural Experiment Station in cooperation with J. B. McInnis.

Conducted at: Lauderdale, Mississippi.

Period: 1940-1941.

Soil: Ruston loamy sand.

Procedure and Conditions: This test was conducted under extremely unfavorable conditions in that an excessive amount of rainfall fell during the growing season. It may have affected the results of the test, at least this fact should be kept in mind in studying the results.

This test was replicated 4 times and all plots were fertilized at the rate of 400 pounds per acre of 0-8-4. Basic slag was used as the source of phosphorus. This test was planted on May 7.

Results:

SPACING OF RUNNER PEANUTS

Spacing	Yield of nuts pounds per acre			Yield of hay pounds per acre		
	1940	1941	Av.	1940	1941	Av.
Rows 24 inches, 6 inches in drill	1,400	1,380	1,390	2,150	2,140	2,145
Rows 24 inches, 12 inches in drill	1,500	1,625	1,562	2,275	2,440	2,357
Rows 24 inches, 18 inches in drill	1,150	1,360	1,255	2,150	1,980	2,065
Rows 30 inches, 6 inches in drill	1,300	1,325	1,612	2,330	2,235	2,282
Rows 30 inches, 12 inches in drill	1,400	1,860	1,630	2,180	2,275	2,227
Rows 30 inches, 18 inches in drill	1.066	1,865	1.463	1.840	2,320	1,580
Rows 36 inches, 6 inches in drill	----	1,420	----	----	1,965	----
Rows 36 inches, 12 inches in drill	----	1,230	----	----	1,688	----
Rows 36 inches, 18 inches in drill	----	990	----	----	1,368	----

Reference: Unpublished data of Mississippi Agricultural Experiment Station, State College, Mississippi.

Spacing Test with Peanuts in Texas

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Angleton Station, Angleton, Texas.

Period: 1915-1922.

Purpose: To find the spacing that would give the largest yields.

Soil: A light colored phase of Lake Charles clay and clay loam soils. The Lake Charles soils are black to dark-gray in color and range from clay to fine sandy loam in texture although the clay is the most extensive type. These soils have dark-gray, heavy clay subsoils.

Procedure and Conditions: The peanuts in these experiments were planted in three-foot rows. During the period of the experiment the size of the plots ranged from 1/44 to 1/11 of an acre.

In these studies the peanuts followed corn in the four-year rotation of corn, cotton, corn and peanuts. During the last six years, however, grain sorghum occasionally replaced the corn in the rotation. After harvesting the stalks of cotton, corn, and the grain sorghum usually were plowed under in the fall or winter as conditions permitted. The entire peanut crop, including vines and nuts, was removed from the land in harvesting.

Generally the peanuts were planted flat on land that had been plowed the preceding fall or winter. In some years, however, low beds were formed on the plowed land with a cultivator and the peanuts planted on these beds. Prior to 1920 the seed was dropped by hand but since that time the seed has been planted with a duplex hopper attachment on a lister planter. In the spacing tests the peanuts were dropped by hand.

As a rule, the small-podded varieties were not shelled before planting but the pods were broken crosswise so that a single kernel was dropped in each hill. The large-podded varieties, however, were shelled because the kernels usually do not fill the pod and have a tendency to drop out if the pods are broken, so that an empty hull would not be planted instead of a kernel.

Occasionally it was necessary to replant the peanuts because of thin stands resulting from low germination of seed, from unfavorable weather conditions immediately after planting, or from damage caused by rodents. Further, the final stands obtained were poor in most years.

The peanuts were given about the same cultivation as cotton. Shallow clean cultivation was practiced. From three to five cultivations were given during the growing season. As a rule the peanuts were hoed twice and occasionally three times, which was one more hoeing than was given cotton.

The peanuts were dug with a walking mouldboard plow. As a rule the row was barred off and then the center strip containing the plants was turned over. The vines were then shaken out of the soil with a pitchfork and all of the plants on each plot, consisting of two or three rows, were heaped together for drying. Two or three days' drying in the field was generally sufficient to cure the vines and nuts for stacking in the hay mow. When the vines did not dry out rapidly enough, they were turned once.

The Spanish variety was used. The nuts were dropped by hand at specified distances in three-foot rows. In most cases full stands were not obtained on account of poor germination and injury from rodents. The final stands, however, were obtained by an actual count of the plants at harvest time.

Miscellaneous: The average yearly rainfall at Texas Substation No. 3, located at Angleton in the Gulf Coast Prairie, approximately 18 miles from the Gulf of Mexico, was 44.53 inches for the 19 years, 1915-1933. While the monthly and yearly rainfall is ample, the distribution often varies widely in individual months and years.

The temperature during the growing season is favorable to the growth of peanuts. The mean maximum temperature ranged from 78.4° F. in April to 92.2° in August. The mean maximum temperature ranged from 57.8° F. in April to 71.9° in July.

Results:

YIELD PER ACRE IN POUNDS OF SPANISH PEANUTS WITH DIFFERENT SPACINGS OF PLANTS IN THREE-FOOT ROWS

Spacing of Plants in Row Inches	1915	1916	1917	1918	1920	1921	1922	Average 1916-1918
3	......	......	2181	807	......	......	......	......
6	......	5244	2061	957	......	......	......	2754
9	2427	4605	2034	771	......	......	......	2470
12	......	4776	2007	696	1440	......	......	2493
15	......	......	......	......	939	672	......	......
18	2235	4521	1815	783	945	564	1725	2373
21	......	......	......	......	1317	273	1554	......
24	......	3477	1509	534	729	......	......	1840
27	1968	......	......	......	777	288	2088	......
30	......	......	......	......	......	279	1710	......
36	1083	2856	......	......	......	204	1194	......
48	......	......	......	......	......	......	846	......

Reference: Texas Agricultural Experiment Station Bulletin 503, "Peanut Growing in the Gulf Coast Prairie of Texas," pages 6, 7, 8, 9, 13, and 14, table 7, College Station, Texas, January 1935.

The Effect of Width of Rows Upon Yield of Peanuts

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Substation No. 11, Nacogdoches, Texas.

Period: 1914-1916.

Purpose: To determine the effect of the width of the row upon the yield of nuts and forage.

Procedure and Conditions: The plantings were made each year in March and normal stands of plants secured in April. The yields in 1916 were reduced on account of damage of moles. Eighteen and thirty-six inch rows were compared.

Results:

ANNUAL AND AVERAGE ACRE YIELDS IN BUSHELS OF NUTS AND TONS OF FORAGE IN 18- and 36-INCH ROWS IN TEXAS

Inches Between Rows	1914		1915		1916		Av. 1914-1916	
	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage
36	36.3	.44	34.6	.80	19.3	.53	30.0	.59
18	36.0	.50	37.0	.77	23.0	.35	32.0	.54

Reference: Texas Agricultural Experiment Station Bulletin 381, "Peanuts in Texas," pages 12 and 13, table 5, May 1928, College Station, Texas.

The Effect of Rate of Planting on Yield of Peanuts

Conducted by: Texas Agricultural Experiment Station.

Conducted at: Substation No. 1, Beeville, Texas.
Substation No. 8, Lubbock, Texas.

Period: Beeville—1918-1924.
Lubbock—1919-1925.

Purpose: To determine the effect the rate of planting has on yield.

Procedure and Conditions: The distance between plants in the row depends upon the variety of peanuts planted, fertility of the soil, and amount of rainfall. Experiments conducted with the Spanish variety at Substation No. 1, Beeville, and Substation No. 8, Lubbock covering a period of five and seven years, indicate that close planting will produce higher yields of both nuts and forage than wide spacing.

Results:

YIELD PER ACRE IN BUSHELS* OF NUTS AND TONS OF FORAGE AT DIFFERENT PLANTING RATES—BEEVILLE, TEXAS

In. Between Plants	1918		1920		1922		1923		1924	
	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage
3	......	......	......	......	37.6	.71	......	1.76	......	......
6	17.0	1.22	......	......	......	......	......	1.41	......	......
9	......	......	35.4	1.06	35.7	.64	......	1.84	......	......
12	15.7	1.04	......	......	81.6	1.39	......	1.01	......	......
15	......	......	32.7	.83	89.4	1.37	......	.83	......	......
18	14.9	.83	27.2	.61	83.6	1.05	......	......	......	.65
21	......	......	......	......	......	......	......	......	......	......
24	13.5	.43	26.8	.57	......		......	......	......	.47
30	13.9	.66	......	.30	......	......	......	......	......	.39
36	13.6	.68	......	......	......	......	......	......	......	.31

*Yield of nuts in this bulletin are calculated at 30 pounds per bushel for Spanish and Macspan and 22 pounds for other varieties.

YIELD PER ACRE IN BUSHELS OF NUTS AND TONS OF FORAGE AT DIFFERENT PLANT RATES—LUBBOCK, TEXAS

Inches Between Plants	1919		1920		1921		1922		1923		1925		6-Yr. Av.	
	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage	Nuts	Forage
6	94.7	1.72	47.6	1.77	60.4	2.28	15.2	1.60	45.1	2.64	35.0	.68	49.6	1.78
9	84.4	1.52	45.6	1.55	51.1	1.74	16.6	1.44	40.2	2.84	35.0	.63	45.4	1.62
12	72.1	1.26	39.7	1.48	47.9	1.65	17.1	1.24	43.2	2.90	32.5	.60	42.0	1.51
15	61.8	1.25	31.1	.99	45.4	1.49	20.1	1.66	41.7	1.84	33.7	.49	39.8	1.20
18	53.5	1.06	32.7	1.14	31.6	1.10	15.7	.81	39.7	2.72	37.5	.72	35.1	1.34

Reference: Texas Agricultural Experiment Station Bulletin 381, "Peanuts in Texas," pages 11 and 12, tables 3 and 4, May 1928, College Station, Texas.

CULTIVATION

Lack of cultivation causes as many crop failures with peanuts as any other thing. It is a crop that must be kept as nearly free from grass as possible.

A test conducted at the Wire Grass Substation, Headland, Alabama, shows the following results:

Peanuts planted: April 20
Norfolk sandy loam soil
No fertilizer used on any plot

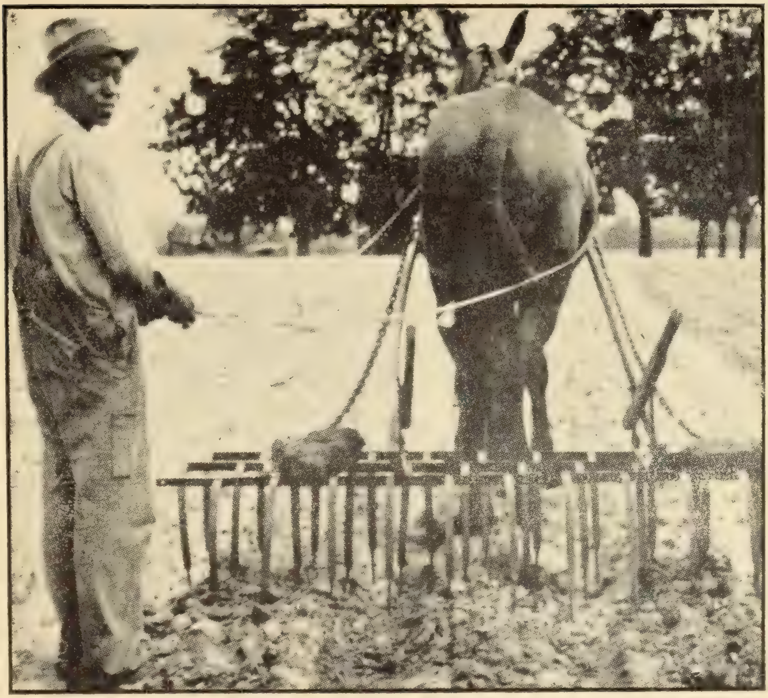

Figure 5.—Cultivating with weeder.

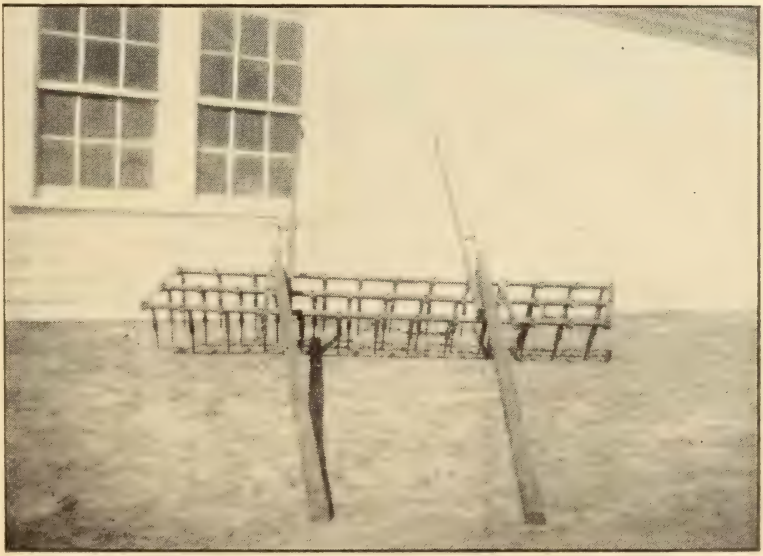

Figure 6.—Showing detail of weeder.

	1939—Peanuts Per Acre
Check plot, clean cultivation, no grass	1150
Little grass	900
Considerable grass	600

The cultivation should begin, according to a summary of the farmers surveyed and the Virginia Experiment Station, not later than the time the peanuts begin to come through the ground. This cultivation may be given with a weeder, or joe harrow, commonly known as top harrow. Figures 5 and 6 illustrate the weeder and its use in peanut cultivation. In most cases where the joe harrow is used one mule is used to pull two harrows. This allows the mule to walk in the middle and does not destroy any peanuts. This cultivation breaks the crust, if any has formed, and destroys the young grass or weeds which may have started to grow. The thought might arise that this cultivation will destroy the peanuts, but it does not because of the way the peanuts are planted. The beds being opened with a straight shovel and the peanuts planted in this furrow, puts them low enough that the weeder or joe harrow only scratches the sides of the furrow and pushes enough dirt in the furrow to cover the small grass or weeds. The critical stage in the cultivation of the peanut crop is when the plants are very young. It is much easier to cultivate the crop when the plants are young than later. At this stage it is possible to cover the young plants almost completely without interfering in the least with their growth, while at the same time the grass is smothered.

In many cases the weeder or joe harrow is used to give up to three cultivations, at four to six day intervals, beginning when the plants first begin to peg through the ground. Cultivating in this way the grass is kept under control and the beds are worked down giving practically a level surface which is very desirable.

After cultivation with the weeder or joe harrow, there are many different methods of cultivation used. Some use the scrape (sometimes known as the heel sweep) as illustrated in figures 7 and 8, with a small lead plow; some bar off real shallow with turning plow and then side with scrape; and some use the joe harrow with the front teeth removed and turning the big end of the teeth down. If the ground is hard enough weight is put on the joe harrow to make it take the ground well. This cultivation will very likely completely cover many of the peanuts, which makes it necessary to follow this cultivation with the weeder to uncover the plants. It is a very satisfactory cultivation because the peanuts are about freed of grass.

The next cultivation is siding with about a 16″ scrape and a small lead plow run shallow and as flat as possible. At this point the peanuts are usually hoed, followed by siding again with scrape or heel sweep. The last cultivation is one furrow in the middle with a 16″ or 18″ scrape or heel sweep run shallow and flat.

Peanuts cultivated in this way seldom require more than one hoeing. Occasionally after laying by some grass is left, and to get the best production this grass should be pulled out by hand. By having the crop as clean as possible the yield is increased and much labor will be saved in harvesting. Ordinary crab grass is the greatest pest of the peanut grower.

References: Farm surveys in Southeast Alabama. Virginia Agricul-

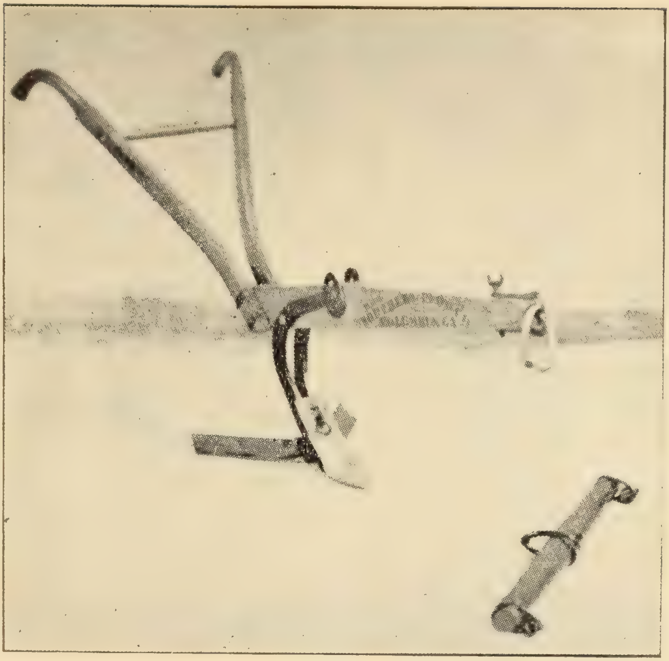

Figure 7.—Scrape or heel sweep.

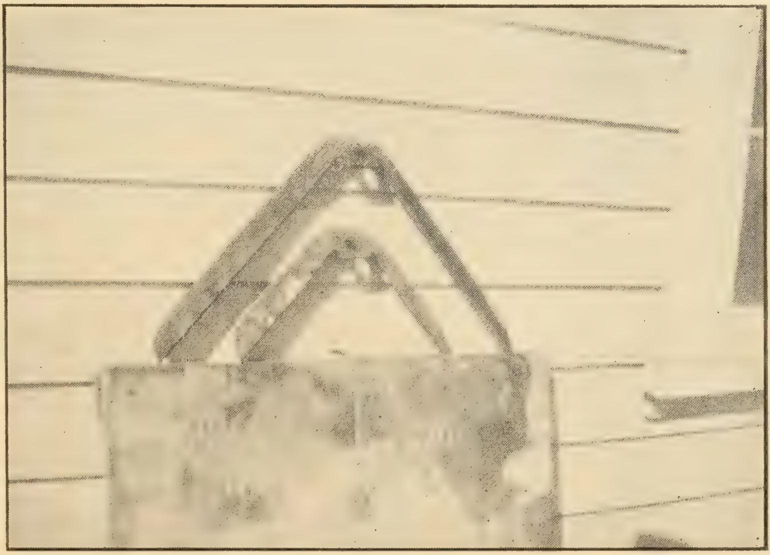

Figure 8.—Scrape or heel sweep.

tural Experiment Station Bulletin 218, "Peanut Culture," page 11, January 1918, Blacksburg, Virginia.

DIGGING

Peanuts must be dug at the right time to secure the maximum yield of Number one nuts. If gathered too early there will be too many shriveled kernels. If gathered too late, some of them will have sprouted. Especially is this true of bunch type peanuts.

According to information secured in Southeast Alabama and from experiment stations, Spanish peanuts should be dug when not more than one peanut is sprouted per bunch. This requires close examination in order to dig at the right time. When the leaves start to turn brown and fall from the vine they are about ready to dig, and at this point they should be examined every day until the first sprouted peanut is observed, and then they are ready to dig. Runners are ready to dig when upon examination it is found that approximately 65 percent of the hulls turn dark inside when burst open, also when the stems begin to turn dark. The runners will stay in the field much longer than the Spanish without serious damage to the nuts.

If the grass worms should eat the foliage from the vines late in the season, it is very necessary that the peanuts be dug within two to four days or all the nuts will come off in the ground.

The idea is to gather peanuts when the most Number 1 nuts can be gotten. A few of the bottom peanuts may have sprouted, a few of the top ones may not be grown, but the bulk of the middle peanuts will, if properly matured, be Number 1 nuts.

Some of the farmers in Southeast Alabama use a eight or ten inch turn plow to dig their peanuts. The mould board and regular point is removed, and a regular peanut point replaces the regular point. Some use a turn plow with the moulboard removed, shown in figure 9. Some use the champion peanut plow, shown in figure 10. This plow has a longer foot and will not choke nearly so quickly as a regular turn plow.

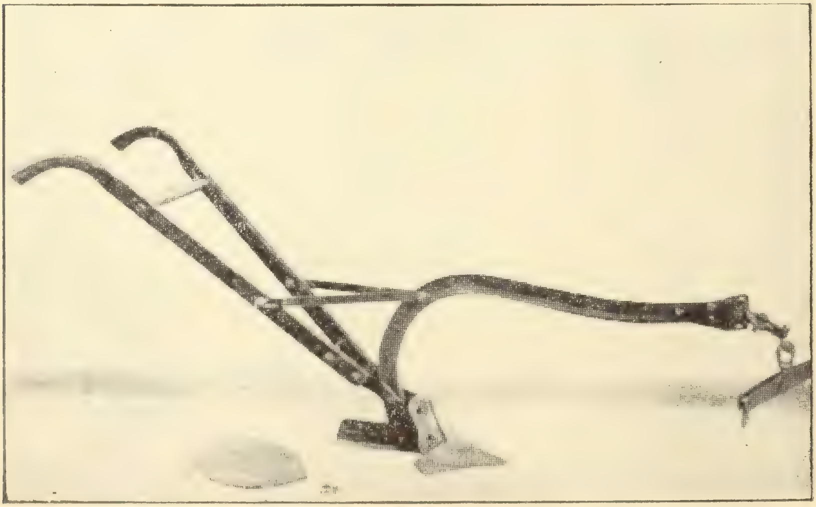

Figure 9.—Turning plow used to dig peanuts.

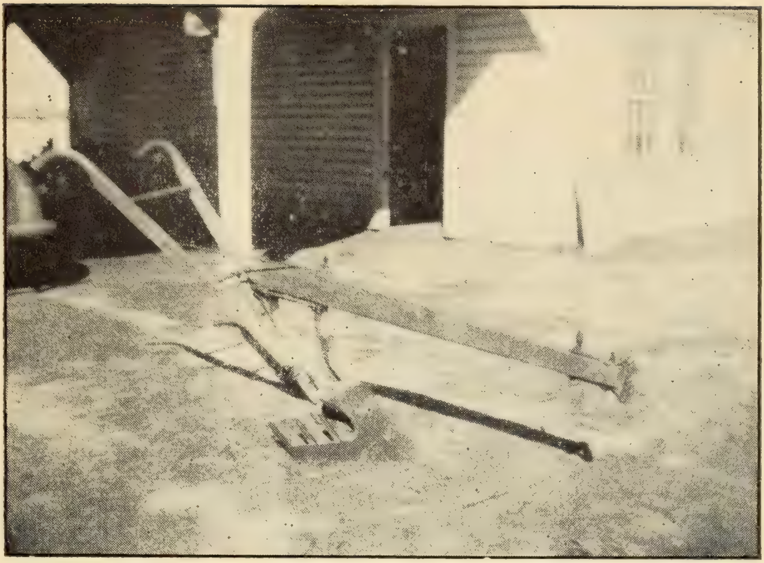

Figure 10.—Champion peanut plow used in digging peanuts.

The plow should go into the field sometime before the stackers, usually about two hours. The uprooted vines and peanuts will then have time to dry out some and the dirt will drop off better. Since dampness will cause damage to nuts, peanuts should never be stacked when the vines are damp or when there is wet dirt clinging to the nuts, because it will cause damaged nuts. The foliage should be perfectly dry before stacking.

Do not dig any more in a day than can be stacked that day. If it rains over night the peanuts left on the ground will be damaged.

STACKING

The peanut producer should be interested in producing the best grade peanuts possible, because the better the grade the higher the price received. To do this peanuts must be properly cured, and to cure properly they must be stacked properly.

Before stacking certain preparations must be made. In securing materials for stacking, the peanut growers of Southeast Alabama cut stacking poles 3 inches to 4 inches in diameter and 7½ feet to 9 feet long. From fifteen to twenty-five poles are required per acre, depending on production. The poles are set from fifteen to eighteen inches deep in the ground by digging hole with post hole digger and tamping the dirt around the pole. Two cross pieces 1 inch by 3 inches by 36 inches to 48 inches are required and should be nailed about 18 inches above the ground as illustrated in figure 11 on which to stack the peanuts in order that 'air' may be allowed to circulate under the stack.

Peanuts should never be stacked in large stacks like stacking hay. The finished stack should be 3 to 5 feet wide and from 6 to 7 feet high. A stack

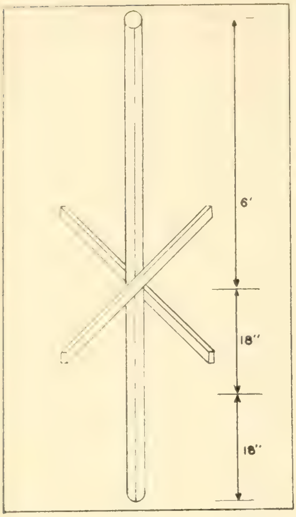

Figure 11.—Pole on which peanuts are stacked for drying.

of this size permits air passage and facilitates curing. When peanuts are put in the stack, they contain considerable moisture, which causes some heating if the stacks are too large. Air cannot circulate adequately through large stacks, thus damaged peanuts and hay result.

The peanut growers of Southeast Alabama stack their peanuts with pitchforks and hand. They begin by placing small forks of vines on the tip ends of the cross pieces until the cross pieces are well covered. They continue placing small forks of peanuts on the stack, rotating around the stack until the stack is 6 feet to 7 feet tall and 3 feet to 5 feet wide. The stack is rounded off at the top and is usually capped with a small amount of grass. No particular care is exercised in placing the nuts and vines in any particular arrangement. They say to stack with the nuts next to the pole is too expensive and that the quality of the nuts will not be affected if the stacks are not too large. Some sources of information recommended stacking with the nuts placed toward the pole and this is a very satisfactory method of stacking, but is not necessary in order to get Number one nuts. In curing the stacks

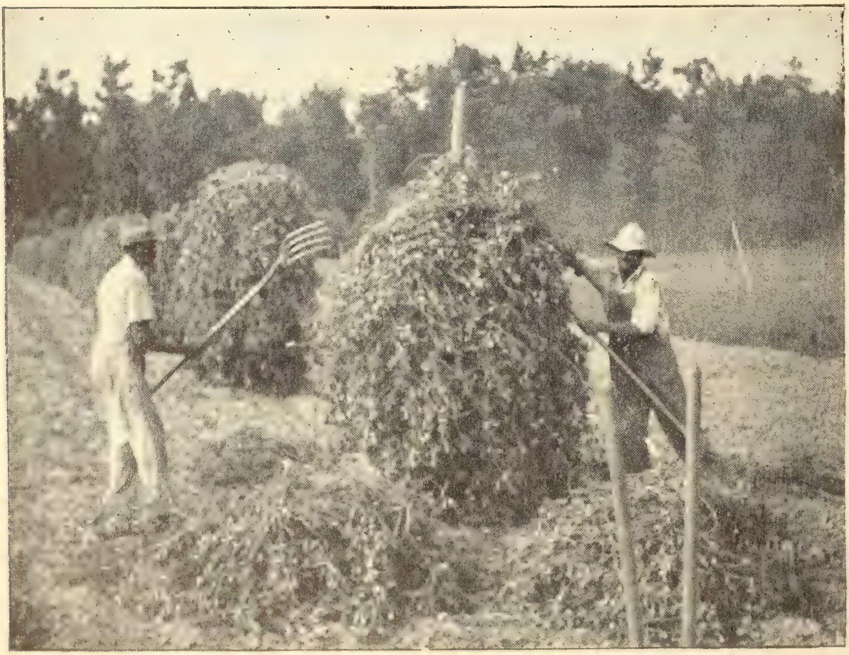

Figure 12.—Placing peanuts on stacked poles for drying.

usually settle. As the stacks settle the cap should be pushed down the pole to prevent rain holes from forming in some of the stacks.

In stacking, a row of stack poles is usually placed every 12 to 15 rows of peanuts, shown in figure 12.

Some growers concentrate their stacks in a small area, and fence separate from the field to keep the stock off. When stacked this way it takes longer to cure and usually they will not cure as well, and the stacking is more expensive because it is necessary to haul the peanuts to the stacks.

PICKING

Peanuts should stay in the stacks from six to eight weeks before picking, the exact duration of the curing period depending upon the kind of weather. Therefore, when to pick should be judged more by the condition of the peanuts than by the length of time they have been in the stack.

If the weather is warm and dry during the curing season, the peanuts might be ready in four weeks. If it has been cold and damp, ten to twelve weeks may be necessary. Three weeks is about the minimum time for curing.

To determine when the peanuts have cured sufficiently to pick requires close inspection after the third or fourth week. To make this examination pull a few of the peanuts out of different stacks from different parts of the field and strip the nuts from the vines: Shell and eat some of the nuts. When they are ready to pick, the nuts should taste ripe and brittle. If the husk will slip off the kernel easily it is a good sign that they have cured enough to pick.

When the picker arrives it should be set in the proper position with the wind. The wind should blow over the feed end of the machine and on out in the same direction the fan is blowing, as in figure 13. This will keep the trash from blowing back into the peanuts. The wind will help the

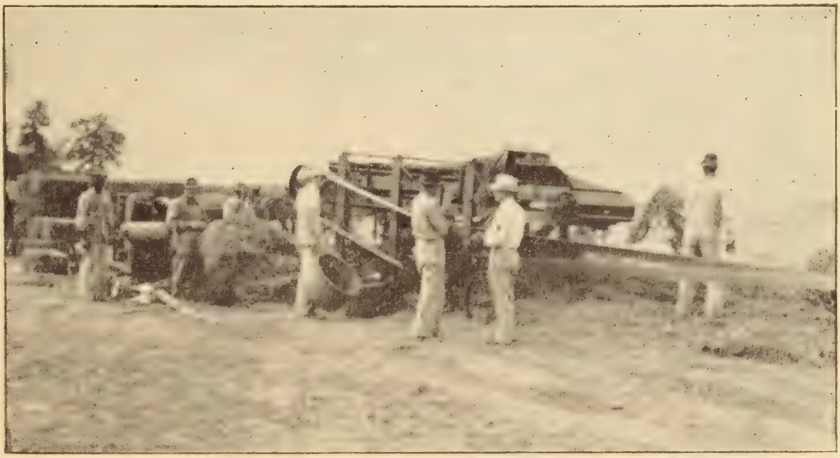

Figure 13.—Peanut picker in operation.

fan to take the trash and hay in the right direction. If the peanuts are trashy they will grade low.

As the peanuts are hauled to the picker, examine each stack very carefully, especially if the curing season has been wet and stormy. Some stacks may be badly damaged throughout. Other stacks may show some damage on the top and bottom of the stack and the middle be all right. The best stacks and the undamaged portions of the partly damaged stacks should be picked together and kept separate.

The damaged stacks and the tops and bottoms of the partly damaged stacks should be picked together and kept separate from the undamaged lot. They will be off-grade. If the good peanuts and bad peanuts are mixed together they will all be off-grade.

A good indication of damaged peanuts is a lot of mould on the vine nearest to the nuts. Some of the peanuts should be shelled out to make certain that they are damaged inside before being put in the damaged or off-grade lot.

Some peanuts are harder to pick clean than others. It is often desirable to run the peanuts through the picker the second time to take out the excess trash. Too much trash will reduce the percentage of kernels and thereby lower the grade.

Very few peanut growers own a peanut picker. They depend in most cases on custom pickers because the cost of the machine is too high for most farmers to own individually. The cost of the picker and power hay baler is from $800 to $900, with the power cost in addition. In Southeast Alabama the custom price for picking averages about $8.00 per ton, including baling the hay. Some pay $9.00 per ton and get the nuts hauled to market. At these prices the grower hauls the peanuts to the picker and moves the hay after it is baled. The average picker will pick from 4 to 8 tons of peanuts per day, depending of course, on the amount of moving that must be done.

PEANUT VINES FOR HAY

In peanut producing areas peanut hay is very valuable as livestock feed if the vines have been properly cured. Henry and Morrison's "Feeds and Feeding" shows the following analyses of hays:

Hay	Digestible nutrients in 100 pounds			
	Crude Protein	Carbo-hydrates	Fat	Total
Peanut vines, pulled nuts removed	6.9	45.3	2.5	57.8
Soybean hay	11.7	39.2	1.2	53.6
Cowpea, all analyses	13.1	33.7	1.0	49.0
Alfalfa, all analyses	10.6	39.0	0.9	51.6
Lespedeza	8.6	41.1	1.1	52.2
Johnson grass	2.9	45.0	1.0	50.1

These analyses show very clearly that peanut hay compares favorably with other kinds of hay.

The summary of the 24 farms surveyed in Southeast Alabama does not show any hay crops used in the cropping system. The farmers in this area depend on the peanuts harvested to supply the needed hay for livestock.

In commercial producing areas peanuts are picked with power pickers and the hay is baled with power balers at the time the peanuts are picked, which reduces the cost of handling, because the picking charge includes hay baling.

Experimental results, together with the experiences of peanut growers, indicate that peanuts harvested and picked with a power picker will yield from 1000 to 2000 pounds of hay per acre.

The market price of peanut hay ranges from $7.50 to $12.00 per ton. The value of the hay will in most cases pay for picking the peanuts, which makes the peanut hay a very important part of the peanut enterprise where the peanuts are harvested.

Digging and Hogging Peanuts

There are two ways of harvesting peanuts: by (1) digging and selling on the market or for home use as feed for livestock, or as food for the family; and by (2) harvesting with hogs, using the pork produced for home use or to sell on the market.

Producing peanuts and digging continuously from year to year has a very bad effect on the yield of succeeding crops. The peanut growers of Southeast Alabama say to never dig two successive crops of peanuts from the same field, but that peanuts dug should be grown in at least a three year crop rotation. Peanuts dug will decrease the yield of succeeding crops where peanuts harvested with hogs will increase the yield of succeeding crops. These points should be considered in setting up a cropping system that includes peanuts.

The Alabama Experiment Station has conducted some experiments showing the effect of digging and hogging peanuts. The results of these tests bring out very clearly that harvested peanuts draw heavily on soil fertility.

The Effect of Harvested Peanuts in Rotation of Corn, Cotton, and Peanuts on Yield of Cotton

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Wiregrass Substation, Headland, Alabama.

Period: 1932-1939.

Purpose: To study various cropping systems involving cotton, peanuts and corn.

Results:

THE EFFECT OF HARVESTED PEANUTS IN ROTATION OF CORN, COTTON AND PEANUTS ON YIELD OF COTTON

Year	Cotton in 2 Year Rotation with Corn*		Cotton in 3 Year Rotation of Corn, Cotton and Harvested Peanuts**			Cotton in 3 Year Rotation of Corn, Cotton and Harvested Peanuts***		
	Yields Per Acre		Yields Per Acre			Yields Per Acre		
	Corn Bu.	Seed Cotton Lbs.	Corn Bu.	Seed Cotton Lbs.	Peanuts Lbs.	Corn Bu.	Seed Cotton Lbs.	Peanuts Lbs.
1932	29.8		26.6			27.7		
1933		1764		1699			1622	
1934	31.7				1934			1960
1935		1656	40.2			31.3		
1936	18.1			1368			1298	
1937		1991			2197			2514
1938	27.5		32.1			29.2		
1939		1201		652			1075	

*Cotton fertilized with 600 pounds per acre of 6-8-4. Corn unfertilized.

**The corn and peanuts were unfertilized; the cotton was fertilized with 6-8-4 at the rate of 600 pounds per acre.

Two crops of harvested peanuts during the 7 year period injured the land to such an extent that 600 pounds of 6-8-4 produced only 652 pounds seed cotton per acre.

***The corn and peanuts were unfertilized, the cotton received 7-8-4 in 1933-1936 and 6-8-12 in 1939 at the rates of 600 pounds per acre.

In 1939, the cotton received 12 instead of 4 percent potash in the fertilizer and produced 423 pounds per acre of seed cotton more than was produced by the 4 percent potash.

Reference: Alabama Agricultural Experiment Station Leaflet 18, "The Effect of 'Digging' and 'Hogging' Peanuts on Cotton Yields," pages 1, 5, 6 and 7, Auburn, Alabama, October 1939.

The Effect of Digging and Hogging Peanuts on Cotton Yields

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Wiregrass Substation, Headland, Alabama.

Period: 1932-1939.

Purpose: To study various cropping systems involving cotton and peanuts

Results:

THE EFFECT OF DIGGING AND HOGGING PEANUTS ON COTTON YIELDS

Year	Continuous Cotton*	Peanuts Harvested Continuously for 7 years, on Cotton the 8th year**	Yield of Seed Cotton in Two Year Rotation with Hogged Peanuts***	
	Yield Seed Cotton Per Acre (Lbs.)	Yield Peanuts Lbs. Per Acre for 7 years and Yield Seed Cotton (lbs.) 8th yr.	Yield in Pounds Peanuts	Yield in Pounds Seed Cotton
1932	731	1852 peanuts	1531	
1933	1406	1212 peanuts		1503
1934	945	1938 peanuts	2113	
1935	1436	1395 peanuts		1492
1936	1366	2173 peanuts	2404	
1937	2063	1518 peanuts		1933
1938	1154	1066 peanuts	2419	
1939	1269	345 seed cotton		1174

*Fertilized with 600 pounds per acre of a 6-8-4. Under this condition, 4 percent potash in the fertilizer seems to be sufficient.

**Cotton after seven years of harvested peanuts. The peanuts were unfertilizde; the cotton received 600 pounds per acre of 6-8-8 fertilizer in 1939.

Seven crops of peanuts removed from the land injured it to such an extent that cotton considered to be well fertilized produced only 345 pounds per acre. Note the declining peanut yields in 1937.

***The cotton received 600 pounds per acre of 6-8-4 until 1939; peanuts received no fertilizer. In 1939 the cotton received 600 pounds per acre of 0-8-4. Under these conditions, 4 percent potash in the fertilizer appears to be sufficient.

In 1939, cotton without commercial nitrogen produced almost as much as continuous cotton which received 600 pounds per acre of 6-8-4. The peanut yields are high compared to peanuts continously for 7 years.

Reference: Alabama Agricultural Experiment Station Leaflet 18, "The Effect of 'Digging' and 'Hogging' Peanuts on Cotton Yields," pages 1, 2, 3 and 4, Auburn, Alabama, October 1939.

LABOR REQUIREMENTS FOR PRODUCING PEANUTS

Labor requirements for producing peanuts were measured by the North Carolina Agricultural Experiment Station on thirty farms in two producing areas. Peanuts were grown in the Craven and Northampton areas. There were 20 farms with an average of 11.65 acres in the Northampton area as compared to 10 farms with an average of 6.2 acres in the Craven area. The average yield of nuts per acre of 1499.4 pounds for the Northampton area was much larger than the 650.5 pounds yield per acre for the Craven area. The cost per pound for the two areas was 1.9 cents and 3.5 cents respectively.

The man and horse labor requirements do not vary a great deal between the two areas. A little more of both man and horse labor was used on the average in the Northampton than the Craven area. This is to be expected, however, especially in the case of harvesting, for the yield was considerably larger in the Northampton area.

AVERAGE LABOR REQUIREMENTS PER ACRE FOR PEANUTS
Craven 1925; Northampton 1927

Area	No. of Farms	Av. No. of Acres Per Farm	Average Yield Per Acre	Man Labor			Horse Labor		
				Prior to Har.	Har.	Total	Prior to Har.	Har.	Total
Northampton	20	11.65	1499.4 nuts 1.56 hay	47.51	33.93	81.44	33.44	7.71	41.15
Craven	10	6.2	650.5 nuts .6 hay	41.12	27.39	68.51	31.34	5.57	36.91

Hay—tons
Nuts—pounds

LABOR REQUIREMENTS BY OPERATIONS PER ACRE ON PEANUTS

Craven 1925; Northampton 1927

Area	No. of Farms	Av. No. of Acres Per Farm	Average Yield Per Acre Lbs.*	Prior to Harvest														
				Breaking		Harrowing and Disking		Running Rows		Distributing Lime and Fertilizer		Planting		Cultivating		Chopping	Total Hours	
				M	H	M	H	M	H	M	H	M	H	M	H	M	M	H
Craven	10	6.2	650.5	3.36	6.65	3.24	5.61	1.06	1.24	2.45	.53	2.76	1.93	13.5	15.38	14.75	41.12	31.34
Northampton	20	11.65	1499.4	5.61	7.91	1.37	1.9	1.39	1.53	3.20	1.58	6.82	4.58	13.90	15.94	15.22	47.51	33.44

	Harvesting								TOTAL HOURS	
	Digging		Cutting Poles, Stacking and Hauling		Threshing		Total Hours			
	M	H	M	H	M	H	M	H	M	H
Craven	19.13	2.95	1.26	1.29	7.0	1.32	27.39	5.57	68.51	36.91
Northampton	14.48	3.53	8.87	2.18	10.58	2.0	33.93	7.71	81.44	41.15

*Peanuts
M—Man hours
H—Horse hours

Reference: North Carolina Agricultural Experiment Station Bulletin 305, "Cost of Producing Farm Products in North Carolina," pages 72, 75 and 76, tables 56 and 58, Raleigh, North Carolina, June 1936.

MARKETING

Marketing is a very important item with any crop that is produced. Before any enterprise is introduced the market possibilities should be determined.

There would be little need for producing a very large acreage of peanuts in Mississippi unless they could be marketed. Prior to 1942 there was a limited market for peanuts in Mississippi, but in other sections of the South there are established markets for peanuts the same as other crops, and as the peanuts are available there will no doubt be markets established in Mississippi.

The peanut growers of Southeast Alabama market their peanuts by selling through the Georgia, Florida, Alabama Peanut Growers Association, oil mills and local buyers.

Peanuts are sold by grades, as are other crops. The specifications for the different grades are given and how the grades are determined.

The prices for peanuts by months is given for all peanuts and for Southeastern Spanish and Runner varieties. This will give some idea as to prices that have been received for a number of years, and may be used as an indication of what price to expect for peanuts in the future.

Grading

In peanut producing areas peanuts are sold by grades. It is very necessary to have standard grades to sell by to protect the seller as well as the buyer. A high percent of farm products are sold by grades. The seller, for his own protection, should know what makes up the different grades.

The United States Department of Agriculture has standard grades set up for peanuts. These grades are used by peanut buyers in the peanut producing areas of the United States.

Small White Spanish peanuts are graded as follows:

Peanuts must be dry, mature, and practically free from damage.

After the SMALL SHRIVELED KERNELS have been sifted out through a screen with FIFTEEN SIXTY-FOURTHS of an inch by THREE-QUARTERS of an inch slotted holes, the balance of the kernels must be as follows:

No. 1 Grade

If there is 70% SOUND & MATURE KERNELS, 2% of DAMAGED KERNELS is allowed.
If there is 71% or more S and M KERNELS, 3% of DAMAGED KERNELS is allowed.

No. 2 Grade

If there is 65% SOUND & MATURE KERNELS, 2% of DAMAGED KERNELS is allowed.
If there is 66% SOUND & MATURE KERNELS, 3% of DAMAGED KERNELS is allowed.
If there is 67% SOUND & MATURE KERNELS, 4% of DAMAGED KERNELS is allowed.
If there is 68% or more S and M KERNELS, 5% of DAMAGED KERNELS is allowed.

No. 3 Grade

If there is 60% SOUND & MATURE KERNELS, 2% of DAMAGED KERNELS is allowed
If there is 61% SOUND & MATURE KERNELS, 3% of DAMAGED KERNELS is allowed
If there is 62% SOUND & MATURE KERNELS, 4% of DAMAGED KERNELS is allowed.
If there is 63% SOUND & MATURE KERNELS, 5% of DAMAGED KERNELS is allowed.
If there is 64% or more S and M KERNELS, 6% of DAMAGED KERNELS is allowed.

If peanuts grade lower than No. 3 they should be sold to an oil mill. The peanut grower should be interest in producing the No. 1 grade peanuts because the highest prices are paid for No. 1 peanuts. Peanut buyers had much rather buy No. 1 peanuts than the lower grades.

The peanut grower may determine the grade of peanuts to be sold by:

1. Take some peanuts from several places in any lot to be graded. Mix thoroughly and spread in thin layer on floor or table.

2. Take out two opposite quarters. Mix two remaining quarters, continue to mix and quarter down until only about 8 ounces are left.

3. Weigh exactly 8 ounces on a Percentage Scale, this will be the full sample or 100 percent.

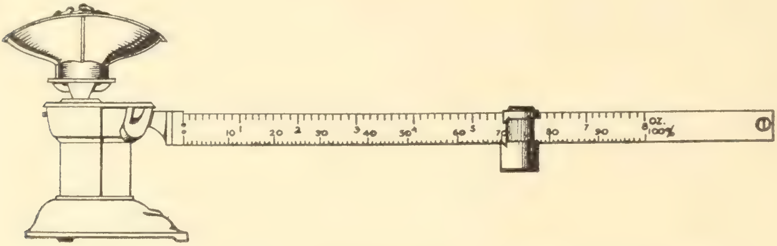

Figure 14.—The Howe Scale Company and the Fairbanks-Morse Scale Company, both of Atlanta, Georgia, sell this scale.

4. Be careful not to lose or add any peanuts to the 8 ounces. If this is done, it will not be the original 100 percent.

5. Pick out "Foreign Material" on scale. Read figures on lower edge of scale; this is the percent of "Foreign Material" in the sample. There is no specified allowance of "Foreign Material," but every percent of it reduces the percent of kernels that much.

6. Pick out "Shelled Peanuts" and weigh. Read figure on lower edge of beam. This will be the percentage of "Shelled Peanuts" in the "Farmers Stock."

Shelled nuts will not run high if peanuts have been properly handled through a Peanut Picker. If they were run through a threshing machine the shelled nuts will be excessive.

7. Shell the sample by hand. Put kernels in one box and hulls in another. Do not drop any of the kernels or leave any in the hulls. Blow the chaff out of the kernels.

8. Shake the kernels over a fifteen sixty-fourths of an inch by three-fourths of an inch screen. This takes out the "Small Shrivels."

9. If any small, slick, immature peanuts pass through the screen, put back with the larger kernels. Weigh the "Small Shrivels" and read the percentage on the lower edge of the beam.

The "Small Shrivels" are sometimes called "Screenings." There is no specific allowance for these in any of the grades but the "Sound and Mature Kernels" will be low if the "Small Shrivels" are high.

10. Spread out the remaining kernels and pick out the "Damaged Kernels."

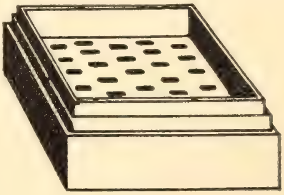

Figure 15.—These screens with a catch tray can be bought from Huntley Manufacturing Company of Brocton, N. Y.

Rancid, decayed, moulded, sprouted, worm cut, kernels with dirt ground in, kernels with yellow meat under the skin or kernels having spots over one-fourth of the skin are considered "Damaged."

Weigh the "Damaged Kernels," read percentage on lower edge of scale beam.

2% to 3% is allowed for No. 1 Grade
2% to 5% is allowed for No. 2 Grade
2% to 6% is allowed for No. 3 Grade

11. Weigh the balance of kernels on scale and read percentage on lower edge of scale. These will be "Sound and Mature Kernels."

To grade No. 1 there must be at least 70 percent of "Sound and Mature Kernels," between 65 percent to 70 percent to Grade No. 2 and between 60 percent and 64 percent to Grade No. 3. Peanuts not coming up to these grades are not suitable for shelling and should be sold to oil mills.

AVERAGE PRICE RECEIVED FOR PEANUTS IN THE SHELL BY FARMERS

Year	Sept. 15	Oct. 15	Nov. 15	Dec. 15	Jan. 15	Feb. 15	Mar. 15	Apr. 15	May 15	June 15	July 15	Aug. 15	Crop Year Av.
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cents
1928	5.0	4.6	4.8	5.1	5.0	5.1	5.1	5.2	5.0	5.1	4.9	4.7	4.95
1929	4.6	4.4	4.0	3.8	3.7	3.5	3.5	3.5	3.7	3.6	3.7	3.8	3.80
1930	3.9	4.2	3.8	3.2	3.2	3.6	3.7	3.9	4.1	3.9	3.8	3.6	3.57
1931	3.1	2.3	2.2	2.0	2.0	1.9	2.0	1.9	1.7	1.6	1.4	1.7	2.05
1932	2.0	1.6	1.6	1.2	1.3	1.3	1.5	1.5	2.1	2.3	2.5	2.6	1.54
1933	2.5	2.5	2.7	2.6	2.9	3.1	3.2	3.4	3.4	3.3	3.2	3.3	2.83
1934	3.3	3.2	3.1	3.3	3.5	4.1	4.4	4.4	4.4	4.1	3.9	3.4	3.29
1935	3.4	3.3	3.1	3.0	3.0	3.1	3.0	3.1	3.3	3.3	3.7	3.8	3.13
1936	3.7	3.5	3.3	3.6	4.1	4.1	4.2	4.5	4.4	4.2	4.0	3.7	3.71
1937	3.4	3.2	3.2	3.2	3.0	3.4	3.5	3.5	3.4	3.5	3.5	3.4	3.21
1938	3.2	3.2	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.28
1939	3.4	3.4	3.4	3.4	3.5	3.6	3.6	3.5	3.7	3.5	3.4	3.4	3.42
1940	3.4	3.3	3.2	3.2	3.3	3.4	3.5	3.6	3.6	4.0	3.4	3.4	3.45
1941	4.5	4.4	4.6	4.8	3.3	3.4	3.5	3.6	3.7	4.0	4.2	4.3	4.02
1942	5.1	5.4											

Reference: United States Department of Agriculture, Agricultural Statistics 1939 and 1941.

PEANUTS: AVERAGE PRICE PER POUND TO GROWERS, F.O.B. COUNTRY SHIPPING POINT BASIS

Southeastern Spanish

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Av.
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
1930-31	3.2	3.1	2.8	3.0	3.4	3.4	3.6	3.6	3.5	3.2	2.8	3.6	3.3
1931-32	1.2	1.2	1.2	1.2	1.2	1.4	1.2	1.0	.8	.8	1.3	1.5	1.2
1932-33	1.2	1.1	.9	1.1	1.1	1.2	1.4	2.1	2.4	2.7	2.7	1.4	1.6
1933-34	2.4	2.5	2.5	2.8	2.7	2.8	2.6	2.6	2.7	2.7	2.7	2.2	2.6
1934-35	2.7	3.0	3.4	4.0	5.0	5.3	4.7	4.6	4.0	3.4	—	2.8	3.9
1935-36	2.9	2.9	2.9	2.7	2.7	2.8	2.9	3.0	3.0	3.4	3.3	3.1	2.9
1936-37	3.0	3.1	3.8	4.4	4.3	4.5	4.4	4.1	3.5	3.5	2.9	3.2	3.7
1937-38	3.0	3.2	3.1	3.2	3.2	3.2	2.9	2.9	3.0	3.0	2.9	2.7	3.0
1938-39	3.0	3.0	3.1	3.1	3.0	2.9	2.9	2.8	2.9	2.9	2.7	2.9	3.0
1939-40	3.3	3.2	3.2	3.4	3.3	3.2	3.1	2.9	2.7	2.6	2.7	3.1	3.1
1940-41	3.0	3.0	3.0										

Southeastern Runners

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Av.
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
1930-31	2.3	2.2	...	----	----	—	----	----	----	..	----	----	2.2
1931-32	1.0	1.0	1.0	0.8	0.8	1.0	0.9	0.8	0.6	0.8	.		0.9
1932-33	1.0	0.8	0.6	0.9	0.9	1.0	1.1	1.6	1.8	...	..	...	1.1
1933-34	2.1	2.1	2.1	2.4	2.5	2.6	2.5	2.5	2.5	2.5	2.5	...	2.4
1934-35	2.4	2.5	3.0	3.3	4.2	4.0	----	...	3.8	----	.	2.4	3.2
1935-36	2.5	2.5	2.5	2.5	2.5	2.4	2.5	2.6	2.5	3.1	3.2	2.5	2.6
1936-37	2.4	2.6	3.2	3.5	3.4	3.7	4.0	3.5	3.3	2.8	2.6	....	3.2
1937-38	2.6	2.7	2.6	2.6	2.7	2.3	2.3	2.3	2.5	2.6			2.6
1938-39	2.6	2.6	2.6	2.6	2.6	2.5	2.4	2.3	2.4	2.4	2.5	2.5	2.5
1939-40	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.4	2.3	2.2	2.2	2.6	2.5
1940-41	2.6	2.6	2.7										

Reference: United States Department of Agriculture, Agricultural Statistics 1939 and 1941.

INSECT PESTS AND DISEASES OF PLANTS

For a long time peanut growers and research workers considered the peanut crop practically immune to the attacks of insect pests and plant diseases. This belief was based on the fact that the entire crop is not destroyed by such attacks when no control measures are used, as is often the case with other crops. The presence of both insects and diseases on peanuts has been observed for a long time, but only recently has any experimental work been conducted to identify such pests and diseases and to develop control measures for them.

The potato leafhopper and leafspot are known to do considerable damage to the peanut crop. During the last few years Virginia has conducted a series of experiments on control methods for the potato leafhopper, and Georgia has started a series of tests on the control of leafspot. These experiments have not been conducted over a long period, but the results that have been gotten should serve as a guide as to how potato leafhoppers and leafspot may be controlled and an indication as to the increase in yields that may be obtained by using the control methods.

Spraying and Dusting to Control Potato Leafhopper on Peanuts

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Holland, Virginia.

Period: 1935, 1936 and 1937.

Purpose: To study the control of the potato leafhopper.

Procedure and Conditions: The Potato Leafhopper—It is not surprising that most growers are not familiar with this small green insect, which is only about one-eighth inch in length when full-grown. It is wedge-shaped in appearance and is yellowish to pale green in color. This very active little species feeds largely on the lower surfaces of the leaves and is capable of jumping or flying when disturbed. The young or immature stages as well as the adults have the unusual ability to run backward or sidewise as rapidly as they can move forward. Frequently when one seeks them on the lower surface of the leaf, they dart around to the upper side without being observed. The egg is a small whitish object, slightly less than one-twenty-fifth inch in length and is not easily observed. The young hoppers are known as nymphs and are similar to the adult in shape but do not have full-grown wings. In their early stages these nymphs are so small and pale-colored that they are difficult to see. During the last three nymphal or immature stages the partially developed wing (wing pads) are present on each side of the body. At the end of the fifth nymphal stage the adult appears and it has full-grown wings. The wings are usually of a paler green color than the rest of the body. The tibia (the longest segment) of each of the hind legs is equipped with two rows of green spines.

Life History: The eggs are deposited in the petioles or larger veins of the leaves where they usually hatch within 4 to 9 days during the summer. The young nymphs pass through four succeeding immature or nymphal stages in their life cycle, shedding their skins at the end of each stage until the adult stage is reached. Soon after the adults appear mating takes place and within a few days eggs are deposited, and a new life cycle begins. The period required for this insect to develop from egg to adult, under most favorable conditions is about 3 weeks. Figure 16 illustrates the life history of the potato leafhopper.

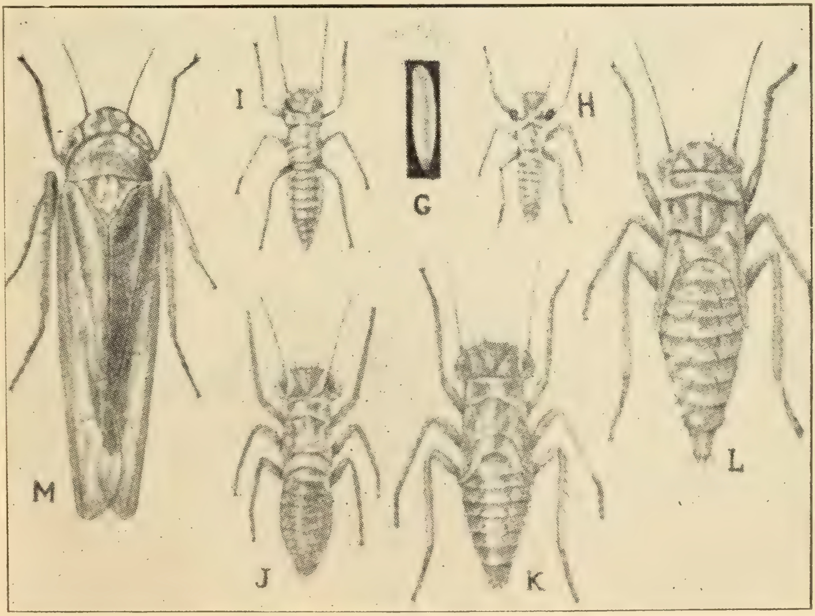

Figure 16.—The potato leafhopper (much enlarged). G, egg; H to L, first to fifth nistars or immature stages; M, adult.

Studies under controlled conditions in an out-of-doors insectary at Arlington Experiment Farm, Arlington, Virginia, showed that this species developed six generations in the period from May to October, inclusive. Under field conditions the generations overlap and cannot be definitely distinguished. The potato leafhopper has a wide variety of host plants. At temperatures between 85° and 90° F., on host plants of exceptional succulence, this species multiplies very rapidly, often becoming extremely abundant on peanuts in Virginia and North Carolina within a period of a few weeks during July and August.

The potato leafhopper frequently does considerable damage to the peanut plants by piercing the leaves and petioles and sucking the juices from them. A burning of the tips and margins of the leaves and a yellowing and dwarfing of the foliage are common symptoms of the disease-like injury, which decreases the yield of forage and nuts materially. The same species of leafhopper injures potatoes severely in many parts of the United States, by causing the injury known as "hopperburn." The potato is one of the preferred food plants of the leafhopper and it often becomes very abundant on this crop. To aid in preventing movement of heavy population of these insects from potatoes to peanuts, it is advisable to avoid planting peanuts adjacent to early potatoes. Figure 17 illustrates how the potato leafhopper injures the peanut plant.

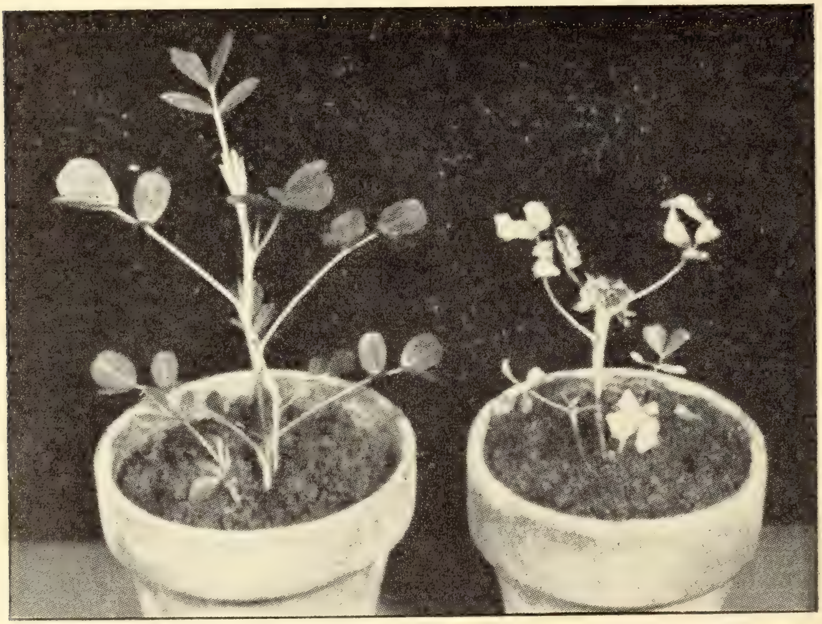

Figure 17.—Injury caused by potato leafhopper.

1935 Experiments: The tests were designed especially to study the effect of various sprays and dusts on yields of peanuts. These tests are listed in the results. Bordeaux spray (2, 3 and 4 applications), Bordeaux dust (3 applications), and the materials used as soil treatments were each applied to four plots. Only duplicate plots were available for the application of the following materials: Copper carbonate, copper sulphate, Bordeaux dust (2 applications) and sulphur (2 and 3 applications). There were 10 check plots distributed among the series of plots.

Sprays: Copper phoshate and copper carbonate were also used as sprays during 1935. The copper phosphate mixture (and similarly the copper carbonate mixture) was mixed dry at the rate of 2 pounds of copper phosphate to 4 pounds of hydrated lime and 2 pounds of bentonite. Care was taken to use in each tank of spray material an amount of copper phosphate or of copper carbonate equal in copper content to that in the Bordeaux mixture so that the results could be compared on this basis.

Dusts: Bordeaux mixture and sulphur in the form of dust were applied to peanuts.

Soil Treatments: Copper sulphate and manganese sulphate each was applied to the soil at the rate of 50 pounds per acre, and zinc sulphate was applied at the rate of 30 pounds per acre during 1935. These materials were applied in the furrow at planting time. The results indicated that these materials had no significant value and they were excluded from the tests made during 1936 and 1937.

There was much earlier shedding of leaves on the untreated check plots and on those which soil treatments were applied at planting time than on the plots to which dusts and sprays were applied. The untreated plots were harvested on November 1, whereas the treated plots remained green and were allowed to grow until November 15. The vines were killed by frost on November 14 but had remained green and had retained most of their leaves until that date. There were no marked differences in this respect in connection with any of the treated plots. The results obtained during 1935, which appear to be significant, were the increases in yield of from 36 to 50 percent obtained by the application of Bordeaux mixture used as a spray and the increase in yield of about 35 percent obtained by the application of the sulphur dust.

1936 Experiments: In 1936 the plan of the work was varied slightly and enlarged. No soil treatments were made. A pyrethrum-sulphur compound (25 percent pyrethrum and 69 percent sulphur) in the form of dust was included among the materials tested. To determine the number of applications necessary in order to obtain the best yield, two applications of each material were applied to each of four plots and three applications of each material to each of four plots. Bordeaux mixture, copper phosphate, and copper carbonate were applied as sprays and sulphur, pyrethrum-sulphur, and Bordeaux mixture were applied as dusts. Eleven untreated check plots were distributed uniformly throughout the experimental area.

Owing to extremely dry soil conditions prevalent in May, planting was delayed until June 1, which retarded somewhat the normal development of the peanut crop. A light frost occurred on October 15 and a killing frost on October 29. All plots were dug November 2. Despite the lateness of planting, the untreated check plots were nearly mature on October 29 but the treated plots were still green and in a thrifty growing condition.

1937 Experiments: The plan of the tests for 1937 was identical with that of 1936, except for the addition of two series of plots to which four applications of Bordeaux mixture as a spray and four applications of sulphur as a dust were applied. These tests were added in order to get additional information regarding the number of applications which should be made in order to obtain the best results.

During July and the early part of August 1937, the peanut crop in the Holland section suffered from the heaviest infestation by the potato leafhopper that has been observed during the past several years. This was especially

SUMMARY OF TESTS TO CONTROL POTATO LEAFHOPPER ON PEANUTS AT HOLLAND, VIRGINIA, 1935-1937

Treatment	1935			1936			1937					Av. Yield of Nuts Lbs.	Av. Inc.
	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Yield of Forage	Inc.		
Untreated check		1296			1200			1782		3548		1426	
4 sprays Bordeaux mixture	July 4, 11 Aug. 12,22	1830	534				July 15 Aug. 4 Sept. 1, 20	2016	234	4314	766	1923	497
3 sprays Bordeaux mixture	July 11 Aug. 12, 22	1944	648	July 22 Aug. 12 Sept. 2	1752	552	July 15 Aug. 4 Sept. 1	2382	600	4446	898	2026	600
2 sprays Bordeaux mixture	July 11 Aug. 22	1770	474	July 22 Aug. 12	1872	672	July 15 Sept. 1	2016	234	3984	436	1889	463
3 sprays copper carbonate	July 11 Aug. 12, 22	1812	516	July 22 Aug. 12 Sept. 2	1872	672	July 15 Aug. 4 Sept. 1	1884	102	3684	136	1856	430
3 sprays copper phosphate	July 11 Aug. 12, 22	1542	246	July 22 Aug. 12 Sept. 2	1872	672	July 15 Aug. 4 Sept. 1	1980	198	3720	172	1798	372
3 dusts Bordeaux mixture	July 11 Aug. 12, 22	822	—474	July 22 Aug. 12 Sept. 2	1602	402	July 15 Aug. 4 Sept. 1	1770	—12	3156	208	1398	—28
2 dusts Bordeaux mixture	July 11 Aug. 22	1140	—156	July 22 Aug. 12	1710	510	July 15 Sept. 1	1782		3792	244	1544	118

SUMMARY OF TESTS TO CONTROL POTATO LEAFHOPPER ON PEANUTS AT HOLLAND, VIRGINIA, 1935-1937– (Continued)

Treatment	1935			1936			1937					Av. Yield of Nuts Lbs.	Av. Inc.
	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Date of Application	Yield Nuts Per A. Lbs.	Yield Inc.	Yield of For-age	Inc.		
4 dusts sulphur							July 15 Aug. 4 Sept. 1, 20	2106	324	5274	1726		
3 dusts sulphur	July 11 Aug. 12, 22	1752	456	July 22 Aug. 12 Sept. 2	1632	432	July 15 Aug. 4 Sept. 1	1974	192	5004	1456	1786	360
2 dusts sulphur	July 11 Aug. 22	1710	414	July 22 Aug. 12	1752	552	July 15 Sept. 1	2010	228	5190	1642	1826	400
3 dusts pyrethrum sulphur				July 22 Aug. 12 Sept. 2	1752	552	July 15 Aug. 4 Sept. 1	2280	498	5154	1606	2016	590
2 dusts pyrethrum sulphur				July 22 Aug. 12	1560	360	July 15 Sept. 1	2064	282	4824	1276	1812	386
50 lbs. copper sulphate per acre to the soil	At planting time	1404	108										
30 lbs. sulphate per acre	At planting time	1350	54										
50 lbs. magnesium sulphate per acre	At planting time	1146	150										

true of peanuts planted near fields of early potatoes. These insects appeared in potato fields in large numbers, greatly curtailing the yield of this crop, and when the potato vines died, or the crop was harvested, the leafhoppers migrated to the nearby peanut fields. Characteristic injury to the peanut foliage was noted early in July and by the last week of the month all plants in some of the fields appeared as though they had been burned. Although this unusually heavy infestation of leafhoppers began to subside early in August, and the plants then made much new growth, the yields both of field-cured nuts and of forage were greatly curtailed. On the plots at the experiment station at Holland the leafhopper infestation was not so heavy as in some of the other sections of the peanut-growing area, but it was much heavier than is normal there.

Reference: Virginia Agricultural Experiment Station Bulletin 316, "Spraying and Dusting to Control the Potato Leafhopper on Peanuts in Virginia," pages 4, 5, 6, 8, 9, 10, 11, 12 and 14, tables 1, 2, and 4, Blacksburg, Virginia, April 1938.

Peanut Leaf Spot Control

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Blacksburg Virginia.

Period: 1941.

Purpose: To compare sulphur dust-gypsum and sulphur dust-lime mixtures against straight sulphur treatment for controlling peanut leafspot.

Soil: Medium dark sandy loam and very light Norfolk fine sandy loam.

Procedure and Conditions: This test was conducted on two farms at Holland, Virginia. In referring to the farms in this test they are designated as Farm A and Farm B.

On the plots treated with sulphur alone 325 mesh dusting sulphur was used. The sulphur dust-gypsum mixture consisted of one part 325 mesh sulphur and three parts Nova Scotia landplaster. The sulphur-lime mixture consisted of one part 325 mesh sulphur and three parts ground oystershell.

The sulphur-gypsum and sulphur-lime applications were applied twice, 200 pounds to the acre per application. Applications were made on July 16 and August 8 on Farm A and July 22 and August 8 on Farm B.

The sulphur dust was applied in three applications, the applications being made July 16, July 25, and August 16 on both farms. The gypsum treated plots received 300 pounds per acre on August 13. This test consists of 1/70 acre plots each treatment being replicated 6 times.

On Farm A peanuts were planted May 8, 1941 and fertilized with 400 pounds to the acre of 0-10-6 under the row. Peanuts were planted in 30″ rows and 12″ on the drill.

On Farm B peanuts were planted May 26 and fertilized with 400 pounds to the acre of 2-10-10 on top of the row. Peanuts were planted in 30″ rows and 12″ on the drill.

Results:

PEANUT LEAFSPOT CONTROL

Designation	Pounds Field-cured Nuts per Acre					
	Farm A		Farm B		Av. Farms A and B	
	Yield	Lbs. Inc. over ck.	Yield	Lbs. Inc. over ck.	Yield	Lbs. Inc. over ck.
Check	2036		2205		2121	
Sulphur	2512	476	2325	120	2418	297
Sulphur-gypsum mixture	2636	600	2137	—68	2386	265
Sulphur-lime mixture	2544	508	2233	28	2389	268
Gypsum	2337	301	1950	—255	2144	23

1. Check plots on Farm A dug October 7, 1941.
2. Treated plots on Farm A dug October 13, 1941.
3. Check plots on Farm B dug October 22, 1941.
4. Treated plots on Farm B dug October 29, 1941.

Reference: Unpublished data. Report of Virginia Agricultural Experiment Station at the Peanut Fertilizer Conference, Atlanta, Georgia, March 11, 1942.

Dusting Spanish Peanuts with Sulphur

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Ten farms in four counties, namely: Terrell, Tift, Mitchell and Daugherty.

Period: 1937.

Purpose: To determine the proper schedule for dusting Spanish peanuts under Georgia conditions and whether such dusting with sulphur might prove profitable.

Procedure and Conditions: A 325 mesh sulphur was used at the rate of approximately 16 pounds per acre for each application. Dusting was begun during the first week in July.

Three dusts were applied for all tests except in Terrell County where four applications were made. The interval between applications was two weeks in all tests except one in Terrell County where the interval was reduced to one week.

In all fields there was a distinct observational difference between the dusted and undusted areas, particularly near harvest time. The appearance of the dusted and undusted vines was similar until about two weeks before harvest when the leaves began shedding rapidly from the undusted vines. Vines receiving sulphur retained from one-half to two-thirds of all leaves, while undusted vines shed all but a few top leaves. The stems of the dusted plants were green while the undusted were brown and dry in appearance. There was leaf-spotting on the dusted plants, the amount present being dependent on the prevalence of spotting at time of first dusting, but leafspot control alone did not seem adequate to explain the resulting increases in yields.

There were increased yields of cured peanuts in all but one instance. The cause of failure in this case is not known. Low increase in yields might be attributed in several instances to lateness in applying the first dust, since the date to begin dusting must be based on the condition of the plants. Also, in several cases, yield increases were small because dust coverage was too light. The dust used was unconditioned and tended to clog the duster, thus interfering with the rate of delivery.

Results:

SUMMARY OF TESTS WITH A 325 MESH SULPHUR AS A DUST ON SPANISH PEANUTS

County	Farm No.	No. of Appli-cations	Yield Peanuts Increase Per Acre		Increase Per Acre	
			Dusted	Untreated		
			Pounds	Pounds	Pounds	Percent
Mitchell	1	3	2598	2193	405	18.5
	2	3	958	848	110	12.9
	3	3	1195	1137	58	5.1
Daugherty	1	3	1187	1023	164	16.0
	2	3	752	848	—96	—11.3
	3	3	1332	1072	261	24.3
Tift	1	3	2155	1648	506	30.7
	2	3	2059	1847	212	11.5
Terrell	1	4	1600	900	700	77.7
	2	4*	1384	1144	240	20.9
Averages			1522	1266	256	20.2

*One-week intervals, all others were applied at two-week intervals.

Reference: Georgia Agricultural Experiment Station Circular 117, "Dusting Spanish Peanuts with Sulphur," pages 1, 2 and 4, table 1, Experiment, Georgia, May 1939.

Dusting Spanish Peanuts with Sulphur

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: One farm in each of the six counties: Tift, Early, Terrell, Mitchell, Decatur and Berrien.

Period: 1938.

Purpose: To determine the proper schedule for dusting Spanish peanuts under Georgia conditions and whether such dusting with sulphur might prove profitable.

Procedure and Conditions: In 1938 a series of 30 plots was staked out in each field. From these a series of 10 plots was dusted twice at two-week intervals, while a second series of 10 plots was dusted three times at two week intervals. Five plots in each series received 10 to 15 pounds of sulphur per acre at each application while the other five plots received 15 to 20 pounds of sulphur per acre at each application. The remaining 10 plots were reserved as undusted checks.

Leafspot counts and yield records were made from these plots; but because of the unusual planting date these records were not included with those from our other field tests.

The peanuts in Tift county were planted April 15 and a good stand was obtained. The plot was fertilized with 0-10-4 at 400 pounds per acre. Tobacco had been grown on the land the previous year and had received 1,000 pounds of 4-8-8. The peanuts were dusted on July 9 and 22, and August 5. They were harvested August 23.

In Terrell county the peanuts were planted April 9, received 200 pounds 3-9-5 and a good stand was obtained. Seventy-five pounds nitrate of soda was applied the previous year to corn. The peanuts were dusted July 11 and 25, and August 9 and harvested August 18.

No fertilizer was applied to the peanuts planted April 10 in Mitchell county, and only a fair stand was obtained. The previous crop was corn and runner peanuts. No fertilizer was applied. July 13 and 28 and August 11 were the dusting dates. The crop was harvested August 19.

The Decatur county plot was planted May 1, no fertilizer was applied and a good stand was obtained. The previous crop was cotton and had received 400 pounds 3-9-5 and had been top-dressed with 75 pounds nitrate of soda. Sulphur dust was applied July 12 and 27, and August 10. The peanuts were harvested August 30.

Results:

DUSTING SPANISH PEANUTS THREE TIMES WITH SULPHUR IN FOUR GEORGIA COUNTIES IN 1938

County	Yield Peanuts Per Acre Lbs. Sulphur Applied Per Acre			Increase Per Acre Lbs. Sulphur Applied Per Acre			
	45-55*	30-40**	Undusted	45-55*	30-40**	45-55*	30-40**
	Pounds	Pounds	Pounds	Pounds	Pounds	Percent	Percent
Tift	2617	2610	2319	298	291	12.85	12.54
Terrell	1359	1386	1268	91	119	7.17	9.3
Mitchell	878	899	737	141	162	19.1	21.9
Decatur	1836	1669	1414	422	255	26.6	18.03
Averages	1672.5	1641	1434.5	238.0	206.5	16.5	14.93

*Total amount three applications. **Total amount two applications.

The response to sulphur dust was evident in all dusted fields. Rainfall was far below normal and Spanish peanuts matured earlier than usual. In some fields dry weather caused extensive early leaf shedding and the crop was harvested earlier than normally would have been the case had the plants retained their leaves. This condition influenced the yield increases to some extent.

The amount of dust applied varied somewhat due to difficulty in calibrating the duster; however, the rates applied came within the range indicated in the table of results. Since both the size of the vines and the number of vines per given area varied in the different fields, the results for the rates of application cannot be considered conclusive. Less than 10 pounds per acre is inadequate for good coverage of all leaves. The average crop required at least 15 pounds for the first application with an increase to 20 pounds for the second and third.

Dusting in fields was begun a week or ten days later than the optimum time. In certain instances the beneficial effects of the sulphur were further reduced by early maturity on account of drought. In Terrell County afternoon showers following each dusting washed off some of the sulphur, thus probably minimizing the results. However, it will be noted that three dustings of sulphur increased the yield in all tests. The highest percentage increase was in Decatur County where the crop was planted late, hence the condition of the plants was not as far advanced at the first dust application as in the other fields. It will also be noted that the highest percentage increase in yield was on peanuts which were not fertilized.

Reference: Georgia Agricultural Experiment Station Circular 117, "Dusting Spanish Peanuts with Sulphur," pages 1, 2, 4, 5 and 6, tables 2 and 3, Experiment, Georgia, May 1939.

The Effect of Various Treatment on Yield of Spanish Peanuts

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1938.

Purpose: To determine whether sulphur has any beneficial effects on peanuts other than disease control.

Procedure and Conditions: The first dust and spray was applied early on a crop that had been planted late and very little leafspot was present at this time. Therefore, the sulphur dust and Bordeaux were more effective in controlling leafspot and preventing leaf shed.

The test has been run only one year and the results cannot be considered as more than suggestive, but they may be of interest to persons planning peanut studies.

Results:

YIELD OF SPANISH PEANUTS FROM PLOTS RECEIVING TREATMENT AS LISTED*

Treatment	Lbs. Per Acre		Increase Per Acre	
	Nuts	Hay	Nuts	Hay
Sulphur—3 dusts	3135	3111	765	716
3-4-50 Bordeaux—3 sprays	3042	3446	672	1051
Landplaster—100 lbs. per acre	3011	2384	641	—11
Sulphur in soil—30 lbs. per acre	2967	2426	697	31
Kainit in soil—125 lbs. per acre	3125	2784	763	389
Complete fertilizer—200 lbs. 6-10-6 per acre	2918	2384	548	—11
Check (no summer treatment)	2370	2395		

*All plots received 200 pounds of a 6-10-6 NPK fertilizer per acre before planting on April 25. The kainit and sulphur in soil were applied to the soil as side-dressings on June 29, the complete fertilizer June 27. The first sulphur dust was applied July 1, and the first Bordeaux spray July 5. The landplaster was sprinkled on the plants June 29.

All plots were harvested August 29.

From the data listed one can readily see that Bordeaux gave slightly better disease control than did the sulphur dust, yet the sulphur dust gave significantly greater increase in yield of nuts. Sulphur in the soil gave only slight control of leafspot but did give a good increase in yield of nuts. Landplaster ($CaSO_4$) gave a very similar increase in yield of nuts, which would seem to indicate that a part of the increase is due to the nutrient value of sulphur. While all other possible factors (for example, the solvent action of oxidized sulphur in the soil, or the value of calcium in landplaster) have not been eliminated, this explanation appears most plausible from the data at hand. This phase of the study will need to be continued over a period of years and on various soil types before definite conclusions may be reached.

Reference: Georgia Agricultural Experiment Station Circular 117, "Dusting Spanish Peanuts with Sulphur," pages 7 and 8, table 4, Experiment, Georgia, May 1939.

Control of Peanut Leafspot

Conducted by: Georgia Agricultural Experiment Station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture.

Conducted at: Tifton, Georgia.

Period: 1937-1940.

Procedure and Conditions: This test was conducted in seven Georgia counties in cooperation with the Bureau of Plant Industry, United States Department of Agriculture, Georgia Coastal Plains Experiment Station, Georgia

Extension Service, the Freeport Sulphur Company, and the Tennessee Corporation.

The sulphur was applied in this test at two week intervals. Three applications were made. The results of the test are shown below.

Results:

YIELDS OF PEANUTS FROM SULPHUR-DUSTED AND CHECK PLOTS

Year	3 applications sulphur dust	Check	Increase
	Pounds	Pounds	Pounds
1937	1,529.5	1,266.0	263.5
1938	1,965.0	1,621.6	343.4
1939	1,611.0	1,200.9	410.1
1940	1,767.3	1,466.2	301.1
Average	1,718.2	1,388.7	329.5

Reference: Georgia Agricultural Experiment Station Annual Report, 1940-1941, page 105, table 59, Experiment, Georgia.

PEANUTS FOR PORK PRODUCTION

According to the 1935 census Mississippi had a total of 311,683 farms. Of this total, 219,727 reported hogs on farms January 1. This leaves a total of 91,956 farms or 29.5% of the Mississippi farms without hogs. These facts would indicate that at least 29.5% of the farms in Mississippi have a problem of supplying the needed pork for home consumption. Pork needed for home use can be obtained only by: (1) purchasing the needed pork for home use, which in some cases is not done due to the low cash farm income, and results in many families going without sufficient pork; or (2) producing the needed pork on the home farm. This may be done by using the feeds that are now available on the farm, or by producing crops not now being grown to be used in producing pork.

At the present time while cooperating under the Soil Conservation Program, many farmers are confronted with the problem of land utilization; that is, trying to use their land to the best advantage. Probably on most Mississippi farms pork production for home use offers a most profitable means to utilize sufficient cultivated land to produce the necessary feed. This land may be planted to several different crops to produce the pork; but under the Soil Conservation Program each farm has a soil-depleting base set up and farms which exceed this soil-dpeleting base are subjected to penalties. This causes some farmers not to have enough feed available for the production of the needed pork and makes it necessary to produce pork with crops that are classed as soil conserving. Examples of such crops are soybeans and peanuts. Peanuts grown and harvested with hogs are classed as a soil conserving crop. By growing peanuts and hogging them off, the needed pork can be produced and the soil be improved at the same time.

Peanuts have been found to be very satisfactory in the production of pork by the Alabama, Mississippi and Georgia Experiment Stations. The following experiments conducted by the Alabama, Mississippi and Georgia Experiment Stations give the results of tests using peanuts in the production of pork as compared with other feeds.

Peanuts for Fattening Hogs in Dry Lots

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: The farm of Parke Thompson, Goshen, Alabama.

Period: 1921-1923.

Purpose: To determine the amount of picked runner peanuts required to produce 100 pounds of gain on fattening hogs in the dry lot.

To compare the relative feeding value of runner peanuts alone; peanuts and corn; peanuts and tankage; and peanuts, corn and tankage.

To test the influence of the above rations on the quality of the carcass.

Procedure and Conditions:

Animals used: All hogs were purebred Poland China of the large type.

Quarters: The quarters were dry lots containing shelter.

Weighing: Individual weights were made at the beginning and every 28 days throughout the test.

Rations: The following rations were fed:

Lot 1—Runner peanuts, self-fed

Lot 2—Runner peanuts
Shelled corn
Free choice

Lot 3—Runner peanuts
60% tankage
Free choice

Lot 4—Runner peanuts
Shelled corn
60% tankage
Free choice

The hogs had access at all times to water and to a simple mineral mixture composed of equal parts by weight of air-slacked lime, salt, and charcoal.

Feeding System for Spring and Fall Litters at Tifton, Georgia

Conducted by: Georgia Coastal Plains Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1935-1937.

Purpose: To compare the pork production on different feeds.

Procedure and Conditions: The 1935 spring litter feed periods were as follows:

Lot 1—April 23 to July 15
Lot 2—July 16 to August 7
Lot 3—August 8 to August 31
Lot 4—September 1 to September 24
Lot 5—September 25 to November 15
Lot 6—November 16 to December 10

The feeding periods for the 1936 spring litters were as follows:

Lot 1—May 5 to July 14
Lot 2—July 15 to August 14
Lot 3—August 15 to September 29
Lot 4—September 30 to October 26
Lot 5—October 27 to November 9

Results:

PEANUTS FOR FATTENING HOGS IN DRY LOT

	First Experiment Dec. 14, 1920—March 21, 1921				Second Experiment Feb. 8—April 23, 1922				Third Experiment Feb. 2—April 3, 1923			
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 1	Lot 2	Lot 3	Lot 4	Lot 1	Lot 2	Lot 3	Lot 4
Number of hogs to lot	6	6	6	6	6	6	6	6	6	6	6	6
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Average initial weight	116.0	117.0	116.0	117.0	76.0	75.8	75.3	75.3	122.0	122.6	120.5	122.5
Average final weight	309.0	282.0	317.0	300.0	194.8	199.5	212.0	227.0	274.0	268.0	285.0	279.0
Average daily gain per hog	1.98	1.69	2.06	1.88	1.58	1.65	1.82	2.02	2.54	2.42	2.74	2.61
Average daily feed per hog												
Runner peanuts	7.07	4.15	7.30	4.45	5.65	4.82	6.38	5.51	9.45	4.75	9.60	6.01
Shelled corn		3.15		2.20		1.90		1.73		4.83		3.53
60% tankage			0.12	0.12			0.40	0.21			0.16	0.12
Total	7.07	7.30	7.42	7.77	5.65	6.72	6.78	7.45	9.45	9.58	9.76	9.66
Feed for 100 pounds gain												
Runner peanuts	356.0	247.0	354.0	290.0	356.9	292.0	349.7	272.5	372.6	196.0	350.2	230.8
Shelled corn		183.0		117.0		115.3		85.6		199.4		135.4
60% tankage			5.7	6.3			21.6	10.9			5.9	4.7
Total	356.0	430.0	359.7	413.3	356.9	407.3	371.3	369.0	372.6	395.4	356.1	370.9

Unfortunately a record of the amount of mineral mixture consumed was not kept in any of these experiments.

The hogs in Experiment 1 were slaughtered at the plant of Swift & Company, Andalusia, Alabama. All carcasses were soft and oily.

The hogs from the second experiment were slaughtered at the plant of the Birmingham Packing Company, Birmingham, Alabama. All carcasses were soft or oily. The carcasses of Lots 1 and 3 appeared somewhat softer than those of Lots 2 and 4 but there was not enough diffreence to affect the commercial value.

The hogs in Experiment 3 were sold to a local dealer. Slaughter data were not obtained, as the results of the two former experiments showed that these rations produced soft or oily carcasses.

Reference: Alabama Agricultural Experiment Station Bulletin 223, "Peanuts for Fattening Hogs in the Dry Lot," pages 2, 3, 4, 5, and 6, tables 1, 2, and 3, Auburn, Alabama, June 1924.

Results:

CONTINUOUS FEED PROGRAM FOR HOGS AT TIFTON—SPRING LITTER, 1935

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
No. pigs to lot	38	38	41	41	41	30
Feeding period, days	84	23	24	24	52	24
Grazing crops (acres)						
Mature oats	5.4					
(Ototan soybeans (no beans set) green grazing		2.2				
Grohoma sorghum (mature) and Otootan soybeans (no beans set)			3.4			
Grohoma sorghum (mature) and Spanish peanuts (mature)				4.1		
Corn (mature) and Hayseed soybeans (mature)					8.3	
Dry lot on corn and tankage						—
Supplement						
Corn (lbs.)	3958	592				5544
Tankage (lbs.)	345	31	47	177	215	155
Cottonseed meal (lbs.)	235	21	32	118	142	104
Total gain (lbs.)	1642	556	598	1324	3046	1490
Total gain per acre (lbs.)	304	253	176	323	367	—
Gain per pig per day (lbs.)	.52	.65	.61	1.35	1.63	2.07
Acres per pig for the period grazed	.142	.057	.082	.100	.202	—

A mineral mixture was self-fed at all times.

CONTINUOUS FEEDING PROGRAM FOR HOGS AT TIFTON, GEORGIA, SPRING LITTER, 1936

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Number pigs to lot	56	52	52	39	9
Feeding period (days)	71	31	46	27	14
Grazing crop (acres)					
Mature oats	3.9				
Early White Dent Corn (Hastings Early) White Dent		6			
Grohoma sorghum and Spanish peanuts			5.45		
Corn and Hayseed soybeans				8.45	
Dry lot on corn and protein supplement					—
Supplements					
Corn (lbs.)	6719				832
Tankage (lbs.)	907	871	1048	467	63
Cottonseed meal (lbs.)	604	580	698	312	42
Total gain (lbs.)	3141	3210	2229	1054	137
Total gain per acre (lbs.)	805	535	409	128	—
Gain per day per pig (lbs.)	.79	1.98	.98	1.00	1.17
Acres per pig for period grazed	.069	.115	.104	.217	—

Note: A mineral mixture was self-fed.

Pigs in the fall litters were weaned on October 22 and November 12 and placed on 7.9 acres of corn and runner peanuts. The crop was planted with one row of corn to four rows of runner peanuts. The yields were 1655 pounds of peanuts and 436 pounds of corn per acre. There was an average daily consumption of .2 pound of tankage per pig during the 81-day period. The daily gain averaged .98 pound per pig. The corn and runner peanuts produced 480 pounds of pork per acre.

On January 11, the 44 pigs were taken from the corn and runner peanuts and placed on nine acres of runner peanuts. The peanuts made an average yield of 2398 pounds per acre. There was an average daily consumption per pig of .28 pound of tankage during the 56-day period. An average daily gain of 1.37 pounds per pig was obtained. Runner peanuts produced 374 pounds of pork per acre. The pigs were fed a mineral mixture during the time they were grazing this area of peanuts and also during the previous period they were grazing the area of peanuts and corn.

References: Georgia Coastal Plain Experiment Station Sixteenth Annual Report 1935-1936, page 59, Tifton, Georgia, September 1936.

Georgia Coastal Plain Experiment Station Eighteenth Annual Report 1937-1938, pages 72 and 73, Tifton, Georgia, July 1938.

Peanuts Grazed Alone versus Peanuts Grazed Supplemented with Corn and Cottonseed Meal Self-Fed

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: October 20, 1920 to November 17, 1920.

Procedure and Conditions: In the fall of 1920, sixteen pigs averaging 47.12 pounds were divided into two lots of eight each. Lot 1 was grazed on peanuts alone while lot 2 was grazed on a comparable area of peanuts and in addition was allowed access to a self-feeder containing a mixture of two parts ground corn and one cottonseed meal. Lot 2 receiving corn and cottonseed meal made 40 pounds more gain than lot 1 on peanuts alone. To produce this extra gain the pigs in lot 2 consumed 258.5 pounds of the mixture of corn and cottonseed meal, the small consumption of grain evidencing the palatability of the peanuts.

Results:

GRAZING PERIOD: OCTOBER 20, 1920 TO NOVEMBER 17, 1920

	Peanuts grazed alone	Peanuts grazed supplemented with corn and cottonseed meal
Number of pigs used	8.	8.
Length of grazing period (days)	28.	28.
Average initial weight (lbs.)	47.12	47.12
Average final weight (lbs.)	83.37	88.37
Average gain per pig (lbs.)	36.25	41.25
Average daily gain per pig (lbs.)	1.29	1.47
Grain fed per pig (lbs.)	—	32.5
Average amount of grain fed daily (lbs.)	—	1.16
Grain fed per cwt. of gain (lbs.)	—	78.9

Grazing Trials with Peanuts at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1919-1922.

Procedure and Conditions: Grazing trials with peanuts were conducted in 1919, 1921 and 1922. The stand during each of the latter two years was probably less than 50 percent of normal which accounts for the small amount of pork produced per acre in these trials. The figures for 1919 are therefore more nearly representative of the results which may be expected in this section of the State with an ordinarily good crop of peanuts. The yield of peanuts that year was estimated at 45 bushels per acre. In 1922 the average daily gain per hog was smaller than either of the other years, owing partially to the scarcity of peanuts in the field during the last week of the trial.

Results:

	1919	1921	1922
Date of starting	Oct. 15	Sept. 30	Oct. 6
Area grazed (acres)	2.3	4.75	4.75
Number of hogs used	12.	12.	12.
Length of grazing period (days)	36.	39.5	38.5
Initial weight, total (lbs.)	1389.	1161.	1515.
Average initial weight (lbs.)	115.75	96.7	126.3
Final weight, total (lbs.)	2190.	2050.	2153.
Average final weight (lbs.)	182.5	170.8	179.4
Total gain (lbs.)	801.	889.	638.
Average gain per hog (lbs.)	66.75	74.08	53.2
Average daily gain per hog (lbs.)	1.85	1.88	1.38
Pork produced per acre (lbs.)	347.8	187.16	134.32

Reference: Mississippi Agricultural Experiment Station Bulletin 218, "Grazing and Feeding Trials with Hogs," pages 6 and 7, tables 3 and 4, State College, Mississippi, June 1923.

Another very serious problem confronting many farmers in Mississippi is the low cash income. Under the AAA program the farmers of Mississippi are limited as to the acreage that can be planted to cotton in the different counties to from 20 percent to 45 percent of their cultivated land. This limited amount of land devoted to producing cash income fails in many instances to supply enough cash for the necessary expenses for food, clothing, and operating the farm. On farms not requiring all non-cotton land to produce food and feed for the farm, there is a very definite problem of land utilization. This excess acreage should be used to produce cash income. If the economic condition of many farmers in Mississippi is to be improved a higher percentage of the cultivated land must be devoted to producing cash income, which under the present set-up will have to be some enterprise other than cotton. There are several enterprises that might be used for this purpose, including: dairying, poultry, beef cattle, hogs, peanuts. Peanuts is a crop that can be produced over a large portion of the State, and can be used in two ways to supplement the farm income: (1) by producing peanuts and harvesting for market; and (2) by producing the peanuts and harvesting with hogs and in turn market the hogs, which provides some cash and improves the soil at the same time.

There are several sections in the Southern States that are successfully producing peanuts, and peanut-fed hogs. North Carolina, Virginia, Georgia, Texas, and Alabama are the leading states in peanut production and in peanut-fed-hog production.

To determine the part that peanut-fed hogs have in the general farm organization in a peanut section, a study of 24 farms was made in Southeast Alabama. A summary of these 24 farms shows a total of 3663 acres in cultivation. Five hundred and seven acres of this land was planted to harvested peanuts, with an average yield of 1135 pounds of peanuts per acre. Six hundred and eighty-three acres were planted solid in peanuts for hogs, producing an average of 285 pounds of pork per acre. Two hundred and eighty-nine acres were planted a row of corn and a row of peanuts. The peanuts for hogs produced approximately 155 pounds of pork per acre. The number of hogs per farm ranged from 7 to 300 head. Twenty-two and seven tenths percent of the cultivated land was devoted to producing peanuts for pork production. The hogs produced 19.83% of the cash income.

The hogs in this section get but little feed other than peanuts, pasture, and other grazing crops. An average of the 24 farms surveyed show that the brood sow and young pigs get 15 bushels of corn per year per farm in addition to peanuts and other grazing crops. A number of farmers plant fall oats and graze these with their hogs during suitable weather in December, January, February and the first of March. This is followed with soybeans grazed in July and August. Spanish peanuts are grazed the last of August and September. When the Spanish peanuts give way the runner peanuts are ready. In following this system the farmers say that there is but a very little time when hogs do not have enough to eat. According to experiments conducted by the Alabama Experiment Station, the following acreage of crops should be planted per sow: 1 acre oats, 1 acre soybeans, 1 acre Spanish peanuts and 3½ to 4½ acres of runner peanuts, plus pasture. This acreage is suggested as sufficient to furnish feed for the sow and her two litters per year.

The brood sow and young pigs are never turned in on fresh ungrazed fields of peanuts. The finishing hogs are turned on the fresh fields and the brood sows and young pigs are used to clean up the scattered nuts, which seems to be enough to keep the brood sow and the young pigs growing very nicely. Too many peanuts available at one time seems to be harmful to young pigs and the brood sow.

"Peanuts are a high-oil, protein-rich feed more concentrated in character than any other known feed. Their concentration compared to the carbonaceous grains is due to the high fat or oil content, which constitutes from 30 to 40 percent of the weight of the kernel, and to the very low fiber content. The protein content runs from 25 to 30 percent, depending on the grade. Feeding experiments and analyses indicate that the chief chemical deficiencies of peanuts when considered as a pig feed are concerned with their supply of minerals, especially calcium and common salt, and vitamin A. The quality of the protein appears to be quite superior."*

In considering the above information it should be borne in mind that every farmer who plants peanuts for hogs will not produce 285 pounds of pork per acre. Some may produce more and some less. The amount of pork produced per acre will depend on the management of the young pigs and the yield of peanuts. The more peanuts produced per acre the more pork an acre is capable of producing.

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*From "Pork Production," by William W. Smith, published in 1937.

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Fertilizers For Starch Sweetpotatoes

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

STATE COLLEGE MISSISSIPPI

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Fertilizers For Starch Sweetpotatoes

By W. S. ANDERSON, Head, Department of Horticulture

The production of sweetpotatoes for starch manufacture is a new but important and increasing agricultural industry in Mississippi.

The nation's first sweetpotato starch factory, equipped for producing a high grade marketable product, was established at Laurel, Miss., in 1934 by the Federal Emergency Relief Administration. Its original purpose was to supply work to unemployed and to provide an additional cash crop to low-income farmers. It has since been operated as a grower-owned cooperative, sponsored by the Farm Security Administration and the Surplus Market Administration. It received 265,000 bushels of sweetpotatoes in 1939, from which was manufactured 2,700,000 pounds of starch. The total production was somewhat less in 1940, and again in 1941, because of unfavorable weather conditions which greatly reduced yields. The planted acreage in 1942 is expected to be greatly increased, and will extend over a larger area than in any former year.

Interest in the use of sweetpotatoes for starch manufacture has been further stimulated, both in the Laurel area and in additional areas, by the coming of war. Large imports of cassava starch have been coming from countries occupied or threatened by Japan, and it is felt highly important that increasing quantities of root starches be produced within the United States.

Starch Sweetpotato Production

The sweetpotato ranks high among potentially valuable southern farm crops, aside from its value as a food crop. The sweetpotato is receiving increased attention as a source of feed for livestock; dehydration studies and feeding tests are being made. The sweetpotato may have possibilities as a source of industrial alcohol, the need for which is acute because of war requirements. As a source of starch, the sweetpotato has proven to be highly efficient. In terms of starch per acre, the production from 150 to 250 bushels of sweetpotatoes per acre means starch yields of, roughly, a ton or more of starch per acre. At the same time, the growing of a sweetpotato crop is laborious and involves considerable expense, and the value per ton of raw material has been rather low under peacetime conditions. Therefore, high yields and minimum-for-efficiency costs of production are necessary for growers to realize any profit.

High total yield at minimum unit cost is the objective in starch sweetpotato production. Market grades, though extremely important in the production of table varieties, are of little importance with the starch sweetpotatoes which are sold "field run" at a given price per bushel or per ton; that is, the price per ton of sweetpotatoes is the same, whether the roots are large or small, or whether smooth or irregular in shape. Since the harvesting of the given weight of large potatoes is easier and less expensive, there is a degree of advantage in the large production of jumbos.

Machine transplanting is apparently a necessity in starch sweetpotato production. The acreage is relatively large on farms where grown, and the largest expenditure of labor is necessary at planting time, which necessarily continues over a period of several weeks. Such labor is usually not available in sufficient quantities, at the moment needed, or is occupied with other crops. Transplanters have not been used for setting sweetpotatoes in the South to any considerable extent until recently, but are being rapidly improved and adapted to the crop. It now appears that it is somewhat less expensive to transplant by machine, rather than by hand, but the difference may not be great. During the war, especially, scarcity of farm labor will undoubtedly result in a wider use of these and other machines in sweetpotato production.

The Triumph variety is used exclusively for starch production in the Laurel area, because of its high starch content, relative freedom from diseases, and high yielding capacity. Numerous other varieties and selections are being tested by research workers in Mississippi and in other Southern states, and while a number of these appear promising, further trials are necessary before any variety other than Triumph can be recommended for starch production under Mississippi conditions.

Schedule of Production Costs

The yield of sweetpotatoes is influenced by several controllable factors. These include: variety, planting date, spacing within the row, fertilization, and other factors. The variation of any or all of these factors may influence the cost of production as well as the yield. For example, closer spacing within the row usually results in higher yields; however, closer spacing requires more plants—which must be purchased or produced—and more labor in setting, hence, greater total expense. Variations in quantity and analysis of fertilizer may considerably influence yield, but these variations also in-

Table 1.—Schedule of costs to the acre of growing sweetpotatoes with different fertilizer treatments.

Fertilizer treatment	Fertilizer and application	Preparation: 2 hoeings, 3 cultivations	Plants and transplanting			Total fixed costs		
			12-inch space	15-inch space	18-inch space	12-inch space	15-inch space	18-inch space
Varying nitrogen, phosphorus, and potash in 800 pounds complete fertilizer per acre								
2-8-4	$ 7.08	$9.62	$17.11	$13.69	$11.41	$33.81	$30.39	$28.11
4-8-4	9.32	9.62	17.11	13.69	11.41	36.05	32.63	30.35
6-8-4	11.08	9.62	17.11	13.69	11.41	37.81	34.39	32.11
8-8-4	13.33	9.62	17.11	13.69	11.41	40.06	36.64	34.36
4-4-4	7.58	9.62	17.11	13.69	11.41	34.31	30.89	28.61
4-12-4	10.62	9.62	17.11	13.69	11.41	37.35	33.93	31.65
4-16-4	12.90	9.62	17.11	13.69	11.41	39.63	36.21	33.93
4-8-8	10.61	9.62	17.11	13.69	11.41	37.34	33.92	31.64
4-8-12	11.89	9.62	17.11	13.69	11.41	38.62	35.20	32.92
4-8-16	12.17	9.62	17.11	13.69	11.41	38.90	35.48	33.20
6-8-8	12.61	9.62	——	——	11.41	——	——	33.64
Varying rates of 4-8-4 from 400 pounds to 2000 pounds per acre								
400 lbs.	4.66	9.62	17.11	13.69	——	31.39	27.97	25.69
500 lbs.	5.77	9.62	17.11	13.69	11.41	32.50	29.08	26.80
800 lbs.	9.32	9.62	17.11	13.69	11.41	36.05	32.63	30.35
1000 lbs.	11.54	9.62	17.11	13.69	11.41	38.27	34.85	32.57
1200 lbs.	13.98	9.62	17.11	13.69	11.41	40.71	37.29	35.01
1500 lbs.	17.31	9.62	17.11	13.69	11.41	44.04	40.62	38.34
1600 lbs.	18.64	9.62	17.11	13.69	11.41	45.37	41.95	39.67
2000 lbs.	23.08	9.62	17.11	13.69	11.41	49.81	46.39	44.11
Varying rates of dolomite, with 800 pounds 4-8-4[1]								
250 lbs.	11.96	9.62	——	——	11.41	——	——	32.99
500 lbs.	12.96	9.62	——	——	11.41	——	——	33.99
1000 lbs.	13.96	9.62	——	——	11.41	——	——	34.99
2000 lbs.	15.96	9.62	——	——	11.41	——	——	36.99

[1] In 1938 only.

fluence the cost of fertilizers and of production. Hence, it is important that certain of these basic costs be understood and kept in mind so that any practice under consideration—in this case, fertilization—may be understood as a part of the total production program and its cost.

The schedule of costs used in the interpretation of the results of fertilizer tests as related to profits expected from the treatments, is shown in table 1. In this schedule the fertilizer cost assumes home mixing of the various ingredients (nitrate of soda, superphosphate, and muriate of potash, unless otherwise noted) and its application with a machine simultaneously with plant transplanting. This is thought to be the cheapest method of fertilizer application. Plants are charged in the schedule at one dollar per thousand. The cost estimates for labor and power of plowing, preparing, hoeing, and cultivating, are based on good farm practices in the Southeastern states.

In addition to the costs of producing the crop, as scheduled in table 1, there are also the costs of harvesting, digging, and hauling to the factory. Under present methods in the Laurel area, different growers spend different amounts on the harvesting and hauling of their crops, because of the varying individual conditions. However, careful estimates indicate that on the average 8¼ cents per bushel will cover these costs. This figure is used in calculating the net profits reported in this bulletin. Because growers are receiving approximately 30 cents per bushel (60 pounds) for their starch sweetpotatoes, the value of the crop from the plots in these experiments has been assumed to be 30 cents per bushel for "field run" potatoes.

In view of the present and potential importance of sweetpotatoes for industrial use, the Mississippi Agricultural Experiment Station has been engaged in a rather complete field of research with this crop since the beginning of the industry in the Laurel area. These experiments have been concerned with plant production, varieties, fertilizers, plant setting and spacing, cultivation, harvesting, storing, and product and by-product processing and utilization.

The experiments have been conducted on different fields and on different farms from year to year. This has served the purpose of quickly acquiring information on several principal types and grades of soil, and has enabled local growers to see and immediately profit by results secured. On the other hand, due to the fact that each of the tests was not located on one plot throughout the experiment, it is believed unwise to average the results.

Sprouts were used for planting throughout these experiments and practically perfect stands were obtained on each plot. The Triumph variety was used.

Since results of fertilizer experiments are beneficial only to the extent they help growers to predict what profits may be expected from their use, the prices of fertilizer materials considered here are what it is anticipated the farmers must pay for them in the spring of 1942. The prices considered are: $40 per ton for nitrate of soda and muriate of potash, and $20 per ton for 18 percent superphosphate. Dolomite was charged at 20 cents a hundred pounds.

The plots were planted on 3½-foot rows; plants were spaced 15 inches in the drill in 1935, 18 inches in 1936 and 1938, and 12 inches in the drill in 1937. The high or moderately high ridge method of land preparation and cultivation was practiced.

In 1935 the experiments were located on new (cultivated one year) Ruston fine sandy loam soil, very old (cultivated about 40 years) Ruston fine sandy loam soil, Orangeburg fine sandy loam soil, and Cahaba fine sandy loam soil. In

1936 new Ruston soil was not included. In 1937 and 1938 only old Ruston and Cahaba soils were used. Cotton, corn, and legumes had been cultivated for many years on the old Ruston and Orangeburg fields, and the Cahaba soil had grown for many years various truck crops which were well fertilized and in rotation with legumes, corn, and cotton. The Orangeburg and Ruston soils used were considered moderately fertile soils, and the Cahaba soil was in a fertile field.

This report presents some of the data secured from experiments with rates and analyses of fertilizers applied to several soils in different years in the Laurel area. Data presented include: the effect of varying the content of nitrogen, phosphorus, and potash in the sweetpotato fertilizer formula, and of varying the application of 4-8-4 fertilizer from 400 pounds to 2000 pounds per acre; the influence of fertilizers upon starch; and the influence of fertilizer on the shape of sweetpotatoes.

Effect of Varying Nitrogen in the Fertilizer Formula

The results obtained from varying the amount of nitrogen in an 800 pound application containing 8 percent phosphorus and 4 percent potash, in addition to nitrogen, are presented in table 2.

These results show that, in general, as the nitrogen was increased the yields of

Table 2.—Influence of varying the proportion of nitrogen in fertilizer upon the grade, yield, and profit from Triumph sweetpotatoes.

Fertilizer (800 lbs.)	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls*	Total	
	1935 Ruston fine sandy loam soil, one year in cultivation					
2-8-4	6	214	16	15	251	24.20
4-8-4	5	204	21	17	247	21.09
6-8-4	5	235	24	18	282	26.94
8-8-4	17	249	23	18	307	30.13
	1935 Ruston fine sandy loam soil, long in cultivation					
2-8-4	0	188	18	19	225	18.55
4-8-4	0	203	29	26	258	23.48
6-8-4	0	237	18	18	273	24.99
8-8-4	0	244	24	18	286	25.56
	1936 Ruston fine sandy loam soil, long in cultivation					
2-8-4	4	150	42	13	209	17.35
4-8-4	0	144	36	15	195	12.06
6-8-4	10	161	16	13	225	16.83
8-8-4	9	171	36	15	231	15.88
	1937 Ruston fine sandy loam soil, long in cultivation					
4-8-4	23	219	31	17	290	27.02
6-8-4	12	226	32	13	283	23.74
8-8-4	20	166	34	18	238	11.70
	1938 Ruston fine sandy loam soil, long in cultivation					
2-8-4	36	279	45	15	375	53.45
4-8-4	34	282	55	11	382	52.73
6-8-4	45	291	48	15	399	54.67
8-8-4	60	277	40	8	385	49.38
	1935 Orangeburg fine sandy loam soil, long in cultivation					
2-8-4	57	330	25	24	436	64.44
4-8-4	37	298	26	25	386	51.32
6-8-4	56	274	20	24	374	46.95
8-8-4	61	264	24	15	364	42.53

(Continued)

Table 2.—Influence of varying the proportion of nitrogen in fertilizer—Continued.

Fertilizer (800 lbs.)	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls*	Total	
	1936 Orangeburg fine sandy loam soil, long in cultivation					
2-8-4	39	177	24	17	255	27.35
4-8-4	25	203	19	17	264	27.07
6-8-4	45	181	22	15	263	25.09
8-8-4	41	207	24	17	289	28.50
	1935 Cahaba fine sandy loam soil, long in cultivation					
2-8-4	4	321	41	22	388	54.00
4-8-4	15	235	33	18	391	52.41
6-8-4	14	336	31	20	401	52.88
8-8-4	23	335	29	13	399	50.14
	1936 Cahaba fine sandy loam soil, long in cultivation					
2-8-4	37	215	34	13	299	36.92
4-8-4	44	256	33	13	346	44.90
6-8-4	32	251	38	10	331	39.88
8-8-4	58	287	33	21	399	52.42
	1937 Cahaba fine sandy loam soil, long in cultivation					
2-8-4	3	240	25	9	277	26.44
4-8-4	0	237	28	10	275	23.76
6-8-4	0	287	36	7	330	33.96
8-8-4	1	278	27	10	316	28.67
	1938 Cahaba fine sandy loam soil, long in cultivation					
2-8-4	44	193	39	11	287	34.31
4-8-4	41	226	26	15	308	36.64
6-8-4	26	240	40	10	316	36.62
8-8-4	29	252	45	14	340	39.59

*Roots ¾" to 1½" in diameter, usually "culled," but suitable for starch.

the larger size potatoes and the total yields were increased. There was little effect upon the yield of the smaller potatoes. The results varied, however, from field to field, and from year to year on similar fields. On the more fertile fields and especially those which grew a good crop of winter legumes, turned under before the sweetpotato planting, differences between the various nitrogen applications were small and insignificant. This was true of the plots on Orangeburg soil in 1935 and on Ruston in 1938. These particular fields were not benefited by the application of nitrogen.

While the highest yields do not always result in the greatest net return to the grower, that in general may be expected. On all of the less fertile fields, where significant increases in yield were obtained by increasing the nitrogen, the greatest net return came from the higher nitrogen application—6 or 8 percent; but on the more fertile soils, where about the same yield occurred on the 2 percent nitrogen application as the higher nitrogen applications, the greatest profit came from the lower nitrogen.

Observation during these investigations has shown that nitrogen is important to sweetpotatoes in insuring a vigorous early vine growth. Sweetpotato vines on soil well supplied with nitrogen have leaves which are dark green and which have long petioles (leaf stems). Figure 1 illustrates the relative size of leaves on plots receiving different amounts of nitrogen. Many growers have expressed the opinion that "too much vine means too little potatoes," and have, therefore, been reluctant to apply enough nitrogen to insure a vigorous growth. Results indicate that if

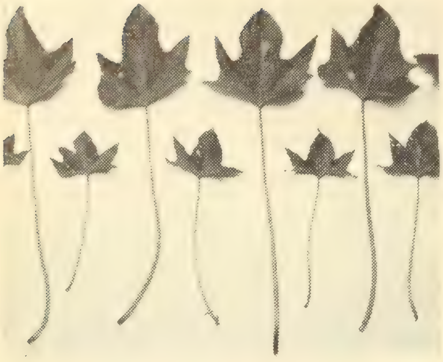


Figure 1-A.—Influence of nitrogen on leaf growth. Top leaves from 8-8-4; bottom from 2-8-4. Cahaba soil 1935.

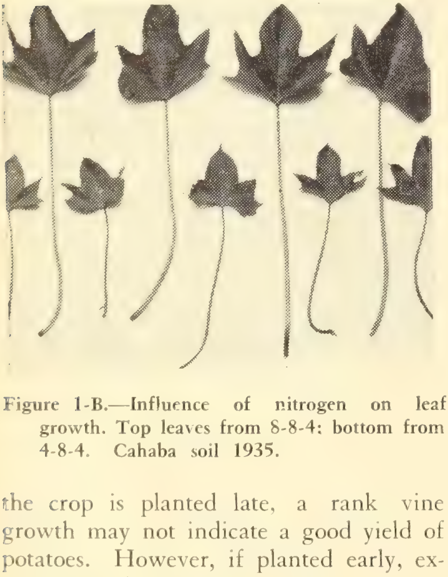


Figure 1-B.—Influence of nitrogen on leaf growth. Top leaves from 8-8-4; bottom from 4-8-4. Cahaba soil 1935.

the crop is planted late, a rank vine growth may not indicate a good yield of potatoes. However, if planted early, experiments show that the better the vine growth, the higher the yield. Because of this relationship, it is possible and altogether feasible to determine shortly after vine growth begins whether the field is deficient in nitrogen, simply by observing the color and vigor of the vines. If applications of nitrogen carrying fertilizers are indicated, they may be made in time to benefit the growing crop.

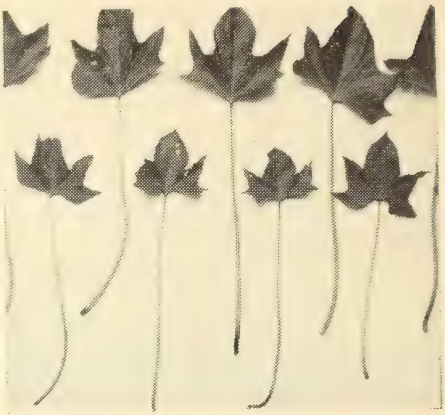


Figure 1-C.—Influence of nitrogen on leaf growth. Top leaves from 8-8-4; bottom from 6-8-4. Cahaba soil 1935.

Figure 2 illustrates the size of sweetpotatoes produced by high and low applications of nitrogen on a soil which needed nitrogen for maximum yields. The difference between the adjacent plots is principally in the yield of the jumbo grade, but roots in the No. 1 grade are on the whole larger in size on the high-nitrogen than on the low-nitrogen plots.

These results indicate that to produce a satisfactory crop of sweepotatoes the grower should see that the soil contains approximately 50 pounds of actual nitrogen to the acre. If he has turned a good crop of winter legumes or heavily manured the land, he may not expect it profitable to apply more nitrogen than that contained in a 2-8-4 mixture. On the other hand, soils not previously enriched will likely yield most profitably when treated with high-nitrogen fertilizer.

Effect of Varying Phosphorus in the Fertilizer Formula

The results from varying the proportion of phosphorus in an 800 pound application containing 4 percent nitrogen and 4 percent potash, in addition to phosphorus, are shown in table 3.

While the results from the varying of

Table 3.—Influence of varying the proportion of phosphorus in fertilizer upon the grade, yield, and profit from Triumph sweetpotatoes.

Fertilizer (800 lbs.)	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls	Total	
1935 Ruston fine sandy loam soil, one year in cultivation						
4-4-4	8	191	26	22	247	22.83
4-8-4	8	205	26	25	264	24.79
4-12-4	19	200	23	18	260	22.62
4-16-4	11	205	27	18	261	20.56
1935 Ruston fine sandy loam soil, long in cultivation						
4-4-4	3	200	22	15	240	21.31
4-8-4	4	182	24	20	230	17.39
4-12-4	4	200	34	32	270	24.79
4-16-4	5	222	22	27	276	23.82
1936 Ruston fine sandy loam soil, long in cultivation						
4-4-4	17	206	25	12	260	27.94
4-8-4	29	212	33	16	290	32.73
4-12-4	27	179	33	18	257	24.25
4-16-4	16	180	37	16	249	20.23
1937 Ruston fine sandy loam soil, long in cultivation						
4-4-4	13	180	50	20	263	22.89
4-8-4	14	202	51	21	288	26.59
4-12-4	8	219	52	19	298	27.46
4-16-4	6	218	49	16	289	23.23
1935 Orangeburg fine sandy loam soil, long in cultivation						
4-4-4	20	316	29	22	387	53.28
4-8-4	28	307	22	22	379	49.80
4-12-4	24	314	29	19	386	50.02
4-16-4	30	330	23	19	372	44.70
1936 Orangeburg fine sandy loam soil, long in cultivation						
4-4-4	13	163	23	21	222	19.68
4-8-4	22	142	29	24	218	17.07
4-12-4	20	164	25	15	224	17.07
4-16-4	36	139	23	17	216	13.05
1935 Cahaba fine sandy loam soil, long in cultivation						
4-4-4	2	257	41	21	321	38.93
4-8-4	9	283	39	25	356	44.80
4-12-4	11	284	37	22	354	43.06
4-16-4	6	301	31	15	343	38.39
1936 Cahaba fine sandy loam soil, long in cultivation						
4-4-4	14	195	39	21	269	29.89
4-8-4	7	236	44	19	306	36.20
4-12-4	27	248	35	16	326	39.26
4-16-4	15	234	30	13	294	30.01
1937 Cahaba fine sandy loam soil, long in cultivation						
4-4-4	0	214	26	14	254	20.94
4-8-4	0	286	28	14	328	35.29
4-12-4	0	219	18	14	251	17.24
4-16-4	0	231	34	15	280	21.27

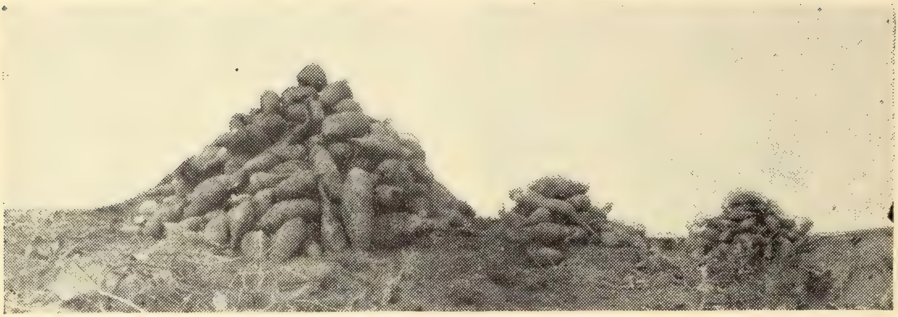
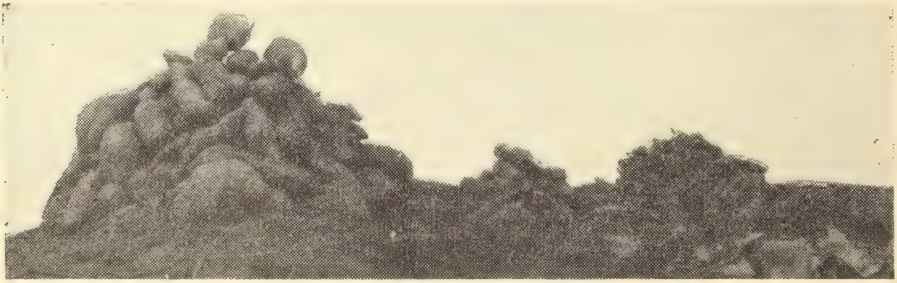


Figure 2-A—Influence of nitrogen on sweetpotato yield and grade. Yield from 2-8-4 on Cahaba soil 1935, Jumbo, 0; No. 1, 320 bushels; No. 2, 40 bushels; and culls, 19 bushels.



Figures 2-B—Influence of nitrogen on sweetpotato yield and grade. Yield from 4-8-4 on Cahaba soil 1935, Jumbo, 0; No. 1, 313 bushels; No. 2, 32 bushels; and culls, 18 bushels.

phosphorus from 4 percent to 16 percent differed considerably between different fields in a single year, and between similar fields in different years, the results show that no significant increases in the total yield or profits were obtained by increasing the proportion of phosphorus. It is noted in one case, the 1937 Cahaba field, that profit as well as yield decreased with higher proportions of phosphorus than 8 percent.

Nine experiments with variations of phosphorus were made in 3 years. The data show that in 5 of these the 8 percent phosphate treatment led in yield and profit; in 2 tests the 12 percent phosphate treatment led in yield and profit; in one it led in yield but not in profit; and in 1 experiment the 4 percent phosphate treatment led in yield and profit. None of these differences are significant, and it is doubtful whether they are large enough to be of practical importance. These results indicate that not more than 50 to 60 pounds to the acre of actual phosphorus need be applied to moderately good soils for sweetpotatoes.

The data show also that the varying amounts of phosphorus applied had no effect upon grade. As was brought out in the discussion of the nitrogen treatments, certain fields had a higher level of fertility and thus made higher yields than other fields. It was observed in these experiments that no difference in the appearance of the plants occurred on the different phosphorus treatments. This was quite different from the observations of the nitrogen and rates experiments.

Figure 3B illustrates sample leaves tak-

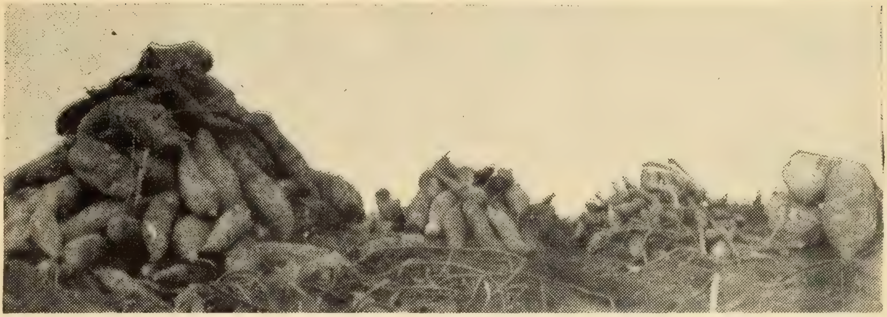


Figure 2-C—Influence of nitrogen on sweetpotato yield and grade. Yield from 6-8-4 on Cahaba soil 1935, Jumbo, 23 bushels; No 1, 369 bushels; No. 2, 32 bushels; and culls, 26 bushels.

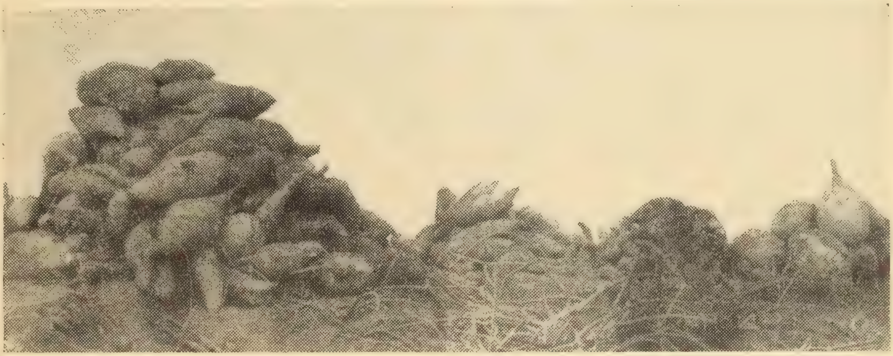


Figure 2-D—Influence of nitrogen on sweetpotato yield and grade. Yield from 8-8-4 on Cahaba soil 1935, Jumbo, 31 bushels; No. 1, 329 bushels; No. 2, 33 bushels; and culls, 22 bushels.

en from plots in one of the fields receiving 4 percent phosphorus and 16 percent phosphorus. There was no difference in the size of the leaf, and the length of the leaf petiole (stem).

Effect of Varying Potash in the Fertilizer Formula

In table 4 are shown the results of varying the proportion of potash in 800 pounds of a mixture which also contained 4 percent nitrogen and 8 percent phosphorus.

These results, like those from the nitrogen and phosphorus experiments, also show considerable variation from field to field, and from year to year. However, the results do show that on new soils a significant increase was obtained in the larger size potatoes and total yield as well as net profits. Potash is a relatively cheap element to supply as fertilizer. In general, when yields are increased by a significant amount from potash applications, the net profits will show similar or proportional increases.

The data in table 4 show that the Ruston soils whether new or old, respond more favorably to potash applications than did the Cahaba and Orangeburg soils used in these experiments. It should be pointed out that the fertility level of the Cahaba and Orangeburg fields used was considerably higher than that of the Ruston fields. The data show that in some cases on Ruston soil there were twice as high yields of jumbos made by

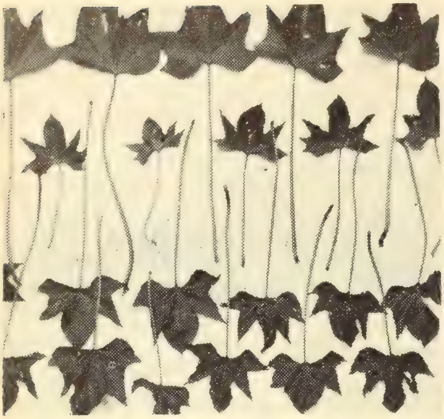


Figure 3-A.—Influence of rates of fertilizer application on leaf growth. Leaf rows, top to bottom, from 2000 pounds, 500 pounds, 1000 pounds, and 1500 pounds of 4-8-4 fertilizer, respectively. Cahaba soil 1935.

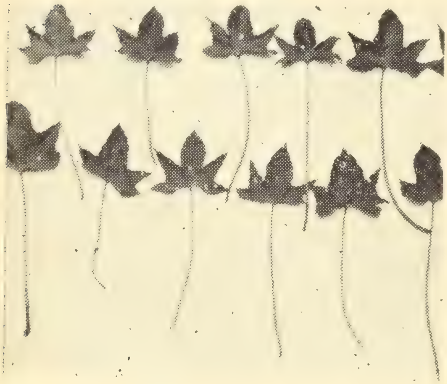


Figure 3-B.—Influence of quantity of phosphorus in complete fertilizer on leaf growth. Upper row of leaves from plot receiving 4 percent phosphorus (P_2O_5); lower row from plot receiving 16 percent phosphorus. Cahaba soil, 1935.

the 16 percent potash as by the 4 percent potash.

A lesser increase in the production of the number one grade was obtained than in the production of the jumbo grade. It can be seen from the table that the potash applications had no influence upon

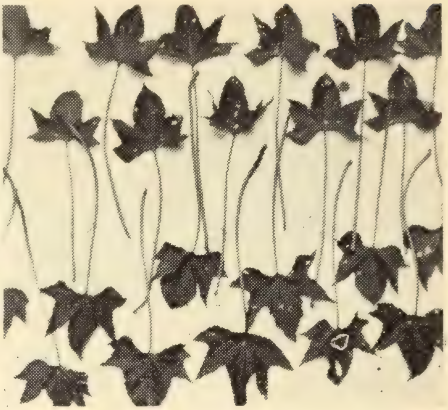


Figure 3-C.—Influence of quantity of potash on leaf growth. Leaf rows, top to bottom, plots receiving 4 percent, 8 percent, 12 percent, and 16 percent potash (K_2O) in complete fertilizer, respectively. Cahaba soil 1935.

the proportion of culls or the number two size, there being practically the same yield from all treatments on any one soil.

Increases due to potash applications, in total yield or profits, did not occur in every field. For example, the Ruston field of 1938, showed both the highest yield and greatest profit from the 4 percent phosphorus application; however, the differences between the treatments were too small to be actually significant. This particular field, though long in cultivation, contained considerable quantities of residual potash as a result of heavy applications in connection with cotton previously grown.

Attention is called to the 1936 results from the Orangeburg field. The differences here in total yield, in number one grade, and in profits were significant; considerably increased profit resulted from each increase in potash applied, with essentially twice as much being realized from the 16 percent as from the 4 percent application. A similar kind of result was obtained from the 1937 field

Table 4.—Influence of varying the proportion of potash in fertilizer upon the grade, yield, and profit from Triumph sweetpotatoes.

Fertilizer (800 lbs.)	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls	Total	
1935 Ruston fine sandy loam soil, one year in cultivation						
4-8-4	7	187	24	13	231	17.61
4-8-8	9	221	20	15	265	23.72
4-8-12	21	224	28	17	290	27.87
4-8-16	15	244	23	18	300	29.77
1935 Ruston fine sandy loam soil, long in cultivation						
4-8-4	9	228	26	18	281	28.49
4-8-8	16	247	24	24	311	33.72
4-8-12	20	249	21	22	312	32.66
4-8-16	13	251	24	24	312	32.38
1936 Ruston fine sandy loam soil, long in cultivation						
4-8-4	17	227	40	11	295	33.81
4-8-8	29	256	33	13	331	40.35
4-8-12	27	257	32	12	328	38.42
4-8-16	19	242	38	12	311	34.44
1937 Ruston fine sandy loam soil, long in cultivation						
4-8-4	11	177	48	23	259	20.28
4-8-8	11	216	45	14	286	24.86
4-8-12	8	169	60	25	262	18.36
4-8-16	21	209	46	18	294	25.04
1938 Ruston fine sandy loam soil, long in cultivation						
4-8-4	19	253	82	26	380	52.30
4-8-8	5	227	84	32	348	44.05
4-8-12	15	231	60	24	330	38.85
4-8-16	10	251	78	24	363	45.75
1935 Cahaba fine sandy loam soil, long in cultivation						
4-8-4	13	292	36	17	358	45.23
4-8-8	9	304	35	20	368	46.12
4-8-12	13	309	34	21	377	46.80
4-8-16	16	272	34	19	341	38.69
1936 Cahaba fine sandy loam soil, long in cultivation						
4-8-4	30	249	30	12	321	39.47
4-8-8	35	229	40	11	315	36.87
4-8-12	42	249	48	16	355	44.29
4-8-16	35	256	38	16	345	41.84
1937 Cahaba fine sandy loam soil, long in cultivation						
4-8-4	3	275	31	12	321	33.77
4-8-8	0	302	35	13	350	38.78
4-8-12	7	357	41	14	419	52.51
4-8-16	4	326	30	12	372	42.01
1938 Cahaba fine sandy loam soil, long in cultivation						
4-8-4	29	231	31	7	298	34.46
4-8-8	28	223	28	8	287	30.78
4-8-12	36	238	38	7	319	36.46
4-8-16	28	219	32	11	290	29.87

(Continued)

Table 4.—Influence of varying the potash in fertilizer.—Continued

Fertilizer (800 lbs.)	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls	Total	
1935 Orangeburg fine sandy loam soil, long in cultivation						
4-8-4	53	250	27	21	351	43.71
4-8-8	49	271	20	22	362	44.81
4-8-12	32	292	21	28	373	45.93
4-8-12	53	261	23	22	359	42.60
1936 Orangeburg fine sandy loam soil, long in cultivation						
4-8-4	29	126	21	13	189	10.76
4-8-8	29	147	26	12	214	14.90
4-8-12	42	145	29	15	231	17.32
4-8-16	48	156	22	16	242	19.44

of Cahaba soil. Considerable difference occurred in the different applications in that field in total yield and profits. Approximately $20 extra profit was realized from the 12 percent potash as compared to the 4 percent, but the 16 percent failed to be as profitable as the 12 percent.

A similar field of Cahaba was used in 1936 and it gave about the same total yields and profits as the 1937 field. Here again it can be seen that the 12 percent potash was most profitable, though not to the same extent as it was on the 1937 field. In 1935 the Cahaba field gave less profit from the 16 percent application, and there was little difference in profit from the 8 percent, 12 percent, and 4 percent applications.

The Orangeburg field planted in 1935 was on the same farm referred to in the paragraphs on the nitrogen experiments; a good crop of Austrian winter peas had been turned under previous to the experiment. It can be noted from the table that practically all yields of the various grades of sweetpotatoes, and all of the profits realized from the several treatments, were not materially different.

All told, there was a considerable variation in the response to varied amounts of potash. Of 5 tests on Ruston soil, 4 percent potash yielded the highest profit in 1 case, second highest in another; 8 percent potash yielded the highest profit in 2 cases, but only slightly more than 12 percent or 16 percent in one of them; and 16 percent potash yielded the highest profit in 2 cases, though only slightly more than 8 percent in one of them. Of 4 tests on Cahaba soil, there was little difference in profits from 4 percent, 8 percent, and 12 percent applications of potash in 1 case; and 12 percent potash yielded the most profit in 4 cases, but the difference was slight in 3 of them. Of 2 tests on Orangeburg soil there was but little difference between profits secured from the 4 treatments in 1935, while in 1936 the highest profits were secured from the highest application of potash.

Effect of Varying the Rate of 4-8-4 Fertilizer

The results obtained from varying the rates of a 4-8-4 fertilizer mixture from 400 pounds to 2000 pounds to the acre, except as indicated, are shown in table 5.

The data on yield and profits from varying the rates of a 4-8-4 show about the same variations as were observed in regard to the variations in nitrogen application. Inasmuch as the results previously discussed indicated that the principal increases in yields obtained on these soils were a result from nitrogen applications, it is believed that the increases in yield shown in table 5 resulted from increased quantities of nitrogen being applied by the increased rates of 4-8-4.

In studying the appearance of the plots during these experiments, it was observ-

Table 5.—Influence of varying the rates of fertilizers upon the grade, yield, and profit from Triumph sweetpotatoes.

Fertilizer lbs. 4-8-4	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit to the acre
	Jumbo	No. 1	No. 2	Culls	Total	
1935 Ruston fine sandy loam soil, one year in cultivation						
400	30	150	20	17	217	19.23
800	10	194	20	17	241	19.79
1200	11	194	24	25	254	17.95
1600	19	231	20	20	290	21.13
2000	46	256	29	25	356	31.04
1935 Ruston fine sandy loam soil, long in cultivation						
400	1	138	32	19	190	13.36
800	3	177	31	22	233	18.05
1200	9	184	29	23	245	16.00
1600	8	218	26	18	270	16.78
2000	17	211	23	13	264	11.03
1936 Ruston fine sandy loam soil, long in cultivation						
400	11	207	40	18	276	34.34
800	16	271	28	19	334	42.31
1200	22	226	30	25	303	30.89
1600	16	258	30	22	326	22.24
2000	20	223	22	20	285	17.88
1937 Ruston fine sandy loam soil, long in cultivation						
500	11	179	36	15	241	18.92
1000	14	213	38	17	282	26.49
1500	25	193	18	11	247	9.68
2000	12	190	24	14	240	11.49
1938 Ruston fine sandy loam soil, long in cultivation						
500	5	239	57	26	327	44.32
1000	8	245	78	29	360	45.73
1500	21	249	72	16	358	49.53
800*	15	235	79	15	344	41.18
1935 Cahaba fine sandy loam soil, long in cultivation						
500	1	150	56	27	234	22.42
1000	4	398	40	22	464	66.07
1500	10	320	35	20	385	43.12
2000	9	302	35	25	371	4.30
1936 Cahaba fine sandy loam soil, long in cultivation						
500	5	142	39	13	201	7.92
1000	12	139	31	15	197	10.82
1500	33	174	36	14	258	17.87
2000	18	188	33	14	253	10.92
1937 Cahaba fine sandy loam soil, long in cultivation						
500	12	305	35	16	368	47.54
1000	17	337	37	12	402	49.17
1500	29	311	31	17	388	40.35
2000	33	307	36	9	385	33.93
1938 Cahaba fine sandy loam soil, long in cultivation						
1500	26	252	20	8	306	29.76
1000	38	262	28	4	332	30.64
1500	77	258	29	5	269	40.92
800*	63	260	28	8	359	44.44

(Continued)

Table 5.—Influence of varying the rate of fertilizer.—Continued

Fertilizer	Bushels (60 lbs.) to the acre of U. S. grades					Dollars profit
lbs. 4-8-4	Jumbo	No. 1	No. 2	Culls	Total	to the acre
	1935 Orangeburg fine sandy loam soil, long in cultivation					
500	30	247	25	26	328	42.26
1000	41	294	23	19	277	47.15
1500	25	251	23	26	325	30.07
2000	61	227	18	20	326	24.52
	1936 Orangeburg fine sandy loam soil, long in cultivation					
500	22	122	31	17	192	46.96
1000	23	171	31	12	237	18.98
1500	38	192	27	15	272	20.92
2000	52	192	26	11	282	17.23

* 6-8-8 mixture

ed that the low rates plots presented about the same appearance as to color of leaves, size of leaves, and length of leaf stems as the low nitrogen plots. The high rates plots also were similar to the high nitrogen plots.

Figure 3A illustrates the difference in size of sample leaves taken, from plots receiving 500, 1000, 1500, and 2000 pounds of 4-8-4 per acre on the Cahaba field in 1935. If this illustration is compared with A, B, and C in figure 1, it can be seen that rates of 4-8-4 influenced leaf growth the same as different amounts of nitrogen.

Figure 4 shows the yield from representative plots of the rates test on Cahaba soil in 1935. The figure illustrates the greater proportion of very large sweetpotatoes made by the plots receiving the higher rates of fertilizer. This matter of the difference in production of large sweetpotatoes by the different fertilizers is important in the production of sweetpotatoes for industrial utilization. Large sweetpotatoes are easier to harvest mechanically, being more readily separated from the lighter particles of soil and stem attachments. Weight for weight, large sweetpotatoes are more cheaply picked-up in harvesting, and are less difficult to handle through conveyors and mills in the factory. The table shows that in general the higher yields of large potatoes came from plots that gave the highest total yields and greatest net profits.

The data in table 5 show that those fields which had a fairly high fertility level with respect to nitrogen, produced the highest yields and showed smaller and insignificant differences in profit between the rates of application. They also show that some fields low in nitrogen made highly significant differences in number one grade and total yield, as well as in net profits. In general, the poor fields showed increased profits even with the 2000-pound rate. On the better fields the profits reached a peak below the 1200-pound application. Again, as in the nitrogen experiments, the most fertile fields and the plots which showed the greatest return from higher rates of applied fertilizer made a greater proportion of large sweetpotatoes.

Influence of Fertilizers Upon Starch Content of Sweetpotatoes

In connection with all of the tests of fertilizers, determinations have been made of the starch and moisture content of sweetpotatoes produced, using 10-root samples from 2 or more plots of a treatment.

The laboratory work on these samples was completed on the day of harvest or the following day, or the samples were preserved in alcohol on the day of harvest and the starch determination made later. Therefore, the starch content figures presented in this bulletin repre-

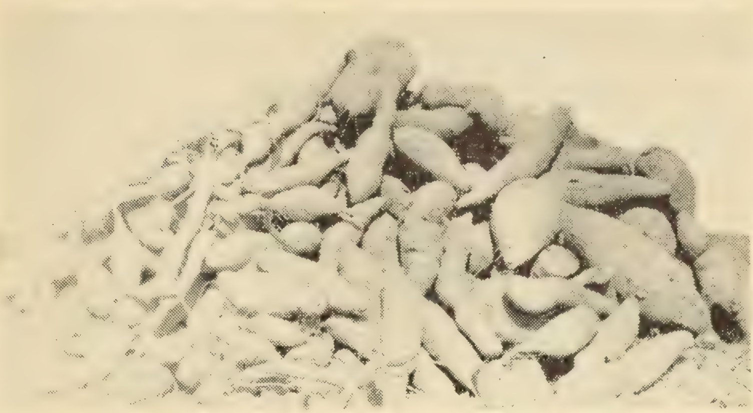


Figure 4-A—Influence of rate of fertilizer application on sweetpotato yield. Yield from 400 pounds 4-8-4 fertilizer on Ruston soil 1935.

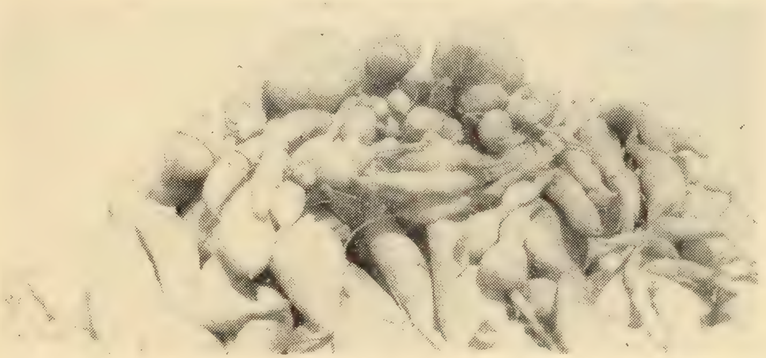


Figure 4-B—Influence of rate of fertilizer application on sweetpotato yield. Yield from 1200 pounds 4-8-4 fertilizer on Ruston soil 1935.

sent amounts contained in the potatoes immediately after harvest, and hence are probably higher than figures for starch content made of potatoes sampled in the bins at the starch factory. In these experiments the starch content determinations were made promptly in order to insure valid comparison between lots.

Average data on starch content obtained for the various treatments, soils, and years, are shown in table 6.

It is not claimed that these results disprove any theory that potash, for example, assists plants in storing starch. It is thought that these plots were on soils that contained moderate quantities of potash; and hence in varying the application from 32 to 128 pounds of actual potash to the acre, it is felt that even at the lowest rate of application there was not a dangerous deficiency of potash.

These data show that in some years and on some soils the potatoes had a higher starch content than on others, but there were no consistent variations and the differences were not significant. Evidently, growers can not depend upon varying the fertilizer application to increase the starch content in sweetpotatoes.

Figure 4-C—Influence of rate of fertilizer application on sweetpotato yield. Yield from 1600 pounds 4-8-4 fertilizer on Ruston soil 1935.

Table 6.—Influence of fertilizers upon starch content of Triumph sweetpotatoes

Treatment	Percent starch in fresh potatoes				
	1935*/	1935**/	1936	1937	1938
(Varying rates)	Ruston soil				
400 lbs. 4-8-4	27.67	25.88	26.37	——	——
500 lbs. 4-8-4	——	——	——	28.21	25.38
800 lbs. 4-8-4	28.33	25.58	26.10	——	——
1000 lbs. 4-8-4	——	——	——	26.59	25.96
1200 lbs. 4-8-4	27.61	26.05	26.71	——	——
1500 lbs. 4-8-4	——	——	——	26.77	24.57
1600 lbs. 4-8-4	25.85	25.33	25.59	——	——
2000 lbs. 4-8-4	25.55	26.35	26.71	24.79	——
800 lbs. 6-8-8	——	——	——	——	25.06
(Varying nitrogen)					
800 lbs. 2-8-4	28.79	30.55	26.86	——	29.77
800 lbs. 4-8-4	28.55	30.55	26.77	27.30	29.23
800 lbs. 6-8-4	28.34	30.19	27.27	26.18	29.11
800 lbs. 8-8-4	28.35	30.51	26.77	26.91	27.31
(Varying phosphorus)					
800 lbs. 4-4-4	29.20	28.93	27.56	27.85	——
800 lbs. 4-8-4	29.74	28.89	26.88	27.95	——
800 lbs. 4-12-4	29.45	30.21	27.54	28.57	——
800 lbs. 4-16-4	30.04	28.80	27.36	27.63	——
(Varying potash)					
800 lbs. 4-8-4	27.12	28.44	26.46	26.95	25.83
800 lbs. 4-8-4	27.63	27.11	26.93	27.22	27.83
800 lbs. 4-8-12	27.67	25.24	23.80	26.46	25.60
800 lbs. 4-8-16	27.62	25.01	23.98	26.78	26.01

(Continued)

Table 6.—Influence of fertilizers upon starch control of Triumph sweetpotatoes.—Continued

Treatment	Percent starch in fresh potatoes				
	1935*/	1935**/	1936	1937	1938
(Varying rates)			Cahaba soil		
500 lbs. 4-8-4	26.10	—	24.48	27.40	26.37
1000 lbs. 4-8-4	25.18	—	23.53	27.72	26.82
1500 lbs. 4-8-4	23.76	—	24.41	27.09	25.20
2000 lbs. 4-8-4	25.47	—	23.04	25.76	—
800 lbs. 6-8-8	—	—	—	—	25.42
(Varying nitrogen)					
800 lbs. 2-8-4	24.48	—	22.14	27.49	24.09
800 lbs. 4-8-4	25.15	—	22.14	27.99	23.80
800 lbs. 6-8-4	27.22	—	22.54	27.45	23.35
800 lbs. 8-8-4	27.42	—	22.27	26.77	21.55
(Varying phosphorus)					
800 lbs. 4-4-4	24.48	—	22.27	26.86	—
800 lbs. 4-8-4	25.83	—	22.63	25.92	—
800 lbs. 4-12-4	26.95	—	22.68	25.87	—
800 lbs. 4-16-4	27.22	—	22.32	26.50	—
(Varying potash)					
800 lbs. 4-8-4	23.64	—	24.61	27.40	24.93
800 lbs. 4-8-8	24.96	—	22.50	27.54	23.62
800 lbs. 4-8-12	22.27	—	23.58	27.33	22.23
800 lbs. 4-8-16	23.40	—	22.86	27.22	23.08
(Varying rates)			Orangeburg soil		
500 lbs. 4-8-4	26.21	—	29.74	—	—
1000 lbs. 4-8-4	26.19	—	28.89	—	—
1500 lbs. 4-8-4	25.96	—	27.90	—	—
2000 lbs. 4-8-4	26.41	—	27.72	—	—
(Varying nitrogen)					
800 lbs. 2-8-4	23.49	—	28.44	—	—
800 lbs. 4-8-4	25.98	—	27.76	—	—
800 lbs. 6-8-4	24.88	—	27.90	—	—
800 lbs. 8-8-4	24.43	—	26.59	—	—
(Varying phosphorus)					
800 lbs. 4-4-4	24.82	—	27.67	—	—
800 lbs. 4-8-4	24.55	—	26.86	—	—
800 lbs. 4-12-4	25.93	—	28.08	—	—
800 lbs. 4-16-4	24.83	—	27.13	—	—
(Varying potash)					
800 lbs. 4-8-4	23.13	—	28.71	—	—
800 lbs. 4-8-8	23.49	—	28.37	—	—
800 lbs. 4-8-12	23.40	—	26.39	—	—
800 lbs. 4-8-16	23.58	—	26.05	—	—

*/ Old land. **/ New land.

Influence of Fertilizers on the Shape of Sweetpotatoes

Experiments in some parts of the country, especially on the very sandy soils of the Eastern states, have shown that varying the constituents of fertilizers affects the shape of sweetpotatoes. For example, it was found in Virginia, New Jersey, and Maryland with the Porto Rico and Big Stem Jersey varieties that high ratios of potash to nitrogen resulted in the production of chunky or round-type roots. Also, that high ratios of nitrogen to potash resulted in the production of elongated roots. The market requirements for table sweetpotatoes are very specific about shape, only spindle-shaped roots bringing the highest prices.

Shape of potatoes grown for industrial utilization is not as important as that for table potatoes, but it is of some practical importance. Round, or globe-shaped roots handle much better mechanically than do long slender ones. They are easier to harvest, convey better in water flumes and other mechanical equipment than the long potatoes. Furthermore, long slender roots are more easily broken in handling, inducing more spoilage in the storage bins.

Because of the interest in having a chunky, or round-type potato, 50 or more No. 1 grade roots were measured on each plot of all of the fertilizer experiments reported in this bulletin. The length and diameter of the roots were measured and an average ratio figure was calculated, representing the shape index which showed whether the potatoes were long and slender (had a large shape index) or whether they were of the round type (had a small index). Thus, a shape index of 2.5 means that the length of the root was 2½ times its diameter.

The data from these measurements of roots from plots where nitrogen and potash were varied on Cahaba and Ruston soils are shown in table 7. These data show that in some years and on some soils the roots were more round than in other years and on other soils. However, the slight variations noted between treatments are not significant and are, therefore, not indicative of fertilizer influence. Shape of the Triumph variety is not as variable as that of the Porto Rico and Nancy Hall varieties. It is only slightly affected by date of planting, which significantly influences the shape of the Porto Rico and Nancy Hall varieties.

It is concluded, therefore, that growers can not expect that fertilizer applications will have any effect upon the shape of the Triumph variety.

Table 7.—Influence of fertilizer on shape of the Triumph Sweetpotato

CAHABA SOIL			
Treatment	Shape index (ratio of length to diameter)		
	1936	1936	1937
(Varying nitrogen)			
2-8-4	2.6		3.1
4-8-4	2.7		3.1
6-8-4	2.8		3.0
8-8-4	2.7		3.3
(Varying potash)			
4-8-4	2.5		
4-8-8	2.5		
4-8-12	2.4		
4-8-16	2.4		
RUSTON SOIL			
(Varying nitrogen)	Shape index (ratio of length to diameter)		
2-8-4	2.1	3.0	—
4-8-4	2.5	3.1	2.9
6-8-4	2.3	2.8	—
8-8-4	2.2	2.9	2.5
(Varying potash)			
4-8-4	2.2	2.9	3.0
4-8-8	2.3	2.7	3.0
4-8-12	2.0	2.8	2.9
4-8-16	2.1	2.9	3.1

Application of These Results to Production of Table Stock Sweetpotatoes

All experimental results reported in the bulletin have concerned the Triumph, a high-yielding, high-starch variety used exclusively, or almost so, in the manufacture of sweetpotato starch. The Triumph is not generally considered as a table variety except perhaps for the very early market; the moist, yellow-fleshed varieties such as Porto Rico and Nancy Hall are generally preferred for table stock.

In view of the very considerable acreage of table stock sweetpotatoes normally grown in Mississippi—which doubtless will be increased because of war needs—these results may be of equal interest to growers of Porto Ricos and Nancy Halls.

It should be emphasized that these data were secured from tests of the Triumph variety only, and no comparisons were made with other varieties. Nevertheless, other research work under way during the same and following years, and in the same and other producing areas—indicate that, in general the effect of fertilizer treatments here reported will likely apply to other varieties of sweetpotatoes produced in the hill sections of Mississippi.

Further information on sweetpotato production may be had from the following recently published bulletins of the Mississippi Agricultural Experiment Station: Bulletin 349, Sweetpotato Plant Production; and Bulletin 358, Sweetpotato Plant Spacing.

Summary and Recommendations

In an expanding field of usefulness, the sweetpotato is being produced in commercial quantities as the raw material of high quality starch in the nation's only sweetpotato starch factory at Laurel, Mississippi. There are other potential uses for the sweetpotato, other than for food.

The Triumph variety is used exclusively, or almost so, for starch manufacture; it yields well and is relatively high in starch content.

Several controllable factors influence the yield of starch sweetpotatoes, and the profit from such production, including: date of planting, plant spacing, variety culture, fertilization. Numerous experiments have been conducted by the Mississippi Station along these and other lines, and bulletins have been published on plant production and on plant spacing. This report concerns fertilization.

In hill sections of Mississippi, sweetpotatoes are fertilized with a complete fertilizer, applied before planting; the mixture most commonly used contains 4 percent nitrogen (N), 8 percent phosphorus (P_2O_5) and 4 percent potash (K_2O). The experiments here reported sought to determine the influence of varying the amount of 4-8-4 fertilizer applied and of varying the proportion of each of the three elements while the other two remained constant; and the influence of such variations was measured by resultant total yields, grades, profits, starch content, and shape.

Varying the amount of nitrogen from 4 percent to 16 percent in a fertilizer mixture which also contained 8 percent phosphorus and 4 percent potash, gave results which indicate that nitrogen is the most important fertilizer element in sweetpotato fertilization. These results show that, in general, as the nitrogen was increased the yields of larger size potatoes, total yields, and profits were correspondingly increased.

It is recommended that sweetpotato growers see that the soil contains approximately 50 pounds of actual nitrogen per acre. This may be supplied with 800 pounds 6-8-4 fertilizer, or with 800 pounds 2-8-4 fertilizer following the turning under of a good crop of winter legumes.

Varying the amount of phosphorus from 4 percent to 16 percent in a mixture which also contained 4 percent nitrogen and 4 percent potash, gave results which indicate that not more than 50 to 60 pounds of actual phosphorus (P_2O_5) need be applied to moderately good soils for sweetpotatoes. This may be supplied by 8 percent or slightly less phosphorus in an application of 800 pounds complete fertilizer per acre.

Varying the amount of potash from 4 percent to 16 percent in a mixture which also contained 4 percent nitrogen and 8 percent phosphorus, gave results which varied rather widely from field to field and from year to year. In general, it appears that not enough potash is included in the 4-8-4 treatment, and that approximately 50 to 60 pounds of potash (K_2O) may be used on soils of average fertility. This suggests 6 percent or 8 percent potash in the 800 pound fertilizer application.

Varying the rate of 4-8-4 fertilizer from 400 pounds to 2000 pounds per acre gave results which indicate the sweetpotatoes benefited chiefly by the extra nitrogen supplied in the larger applications. On better fields the profit reached a peak below the 1200-pound application, while the poor fields showed increased profit even with the 2000-pound rate.

Influence of fertilizers on starch content and shape. While results varied slightly from field to field and from year to year, the data give no conclusive evidence that fertilization affects materially either the starch content or the shape of Triumph sweetpotatoes.

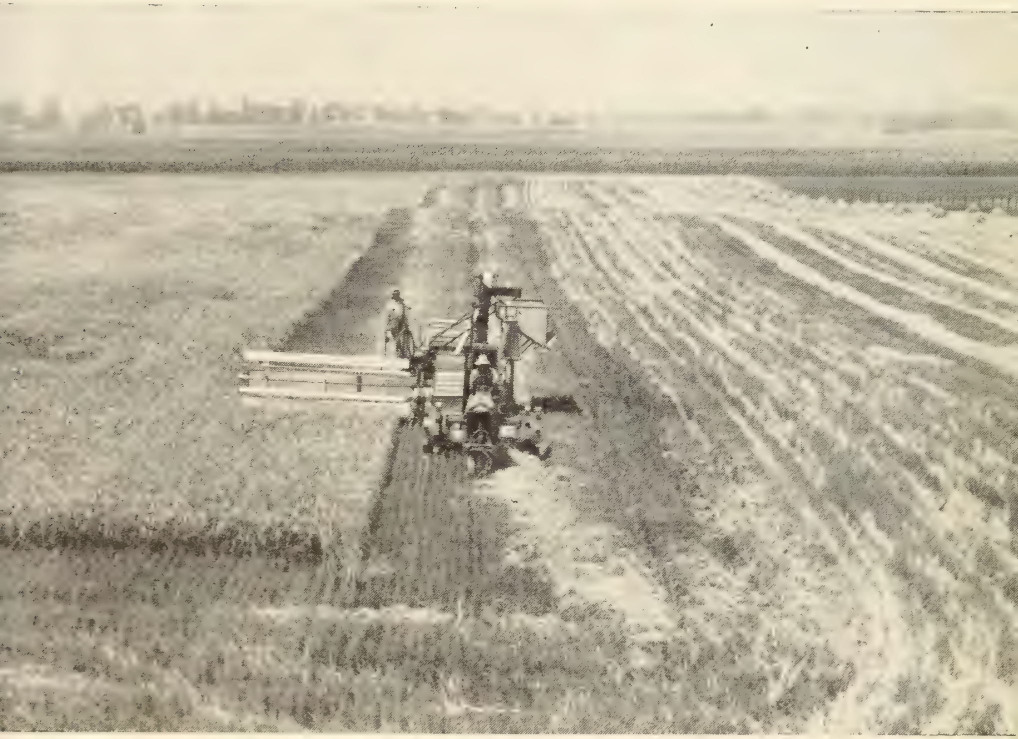
Summarizing all of the foregoing, it appears that Mississippi soils used largely for sweetpotato production respond favorably to fertilizer applications of approximately 50 pounds nitrogen (N), 50 pounds phosphorus (P_2O_5) and 50 pounds potash (K_2O). Approximately half the nitrogen may be supplied with a winter legume crop, turned under.

The suggested amount of plant food would be approximately supplied by 600 pounds 8-8-8, or 800 pounds 6-6-6, or from a home mixture of 300 pounds nitrate of soda, 250 pounds 20 percent superphosphate, and 100 pounds muriate of potash.

BULLETIN 368 JUNE 1942

Corn and Oats

A Compilation of Information on Comparison, Utilization, and Production of Grain Feeds for Mississippi Farms



Compiled by H. O. WEST, Coordinator Research Information
Jointly Representing Mississippi State Vocational Board
and : : Mississippi Agricultural Experiment Station

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Corn and Oats

Compiled by H. O. WEST*

Corn and oats are the main grain food and feed crops produced in Mississippi. At present corn is by far the more important, but during the last few years there has been a definite increase in the acreage of oats produced for grain. The average acreage planted to corn in Mississippi during the last 10 years has been approximately 2½ million acres annually. The acreage of oats in Mississippi for 1941 was approximately 280,000 acres. In addition to corn and oats, there has been a small acreage planted to miscellaneous grains. The combined acreage of all grains does not produce enough grain to satisfy the needs of the state, so that Mississippi still imports grain feeds each year. This is due in large part to the low average acre-yield of corn.

There has been a definite change in methods of farming in Mississippi during the past few years. This change has been brought about in part by the increased use of power equipment. The labor situation has done a great deal toward causing this shift. In the present emergency there seems to be a need for a change in the farming set-up on many farms due to the increasing labor shortage. It may become necessary to switch from the production of some crops in order to conserve labor—to engage more largely in the production of crops that can be handled mainly with power equipment.

It is felt that there is a possibility of changing the practices followed in producing grain in Mississippi. An attempt is made in Part I of this publication to present information that should be helpful in planning a grain production program. The information is based on experiment station results as well as on a study of corn and oat production practices used by Mississippi farmers and other results.

In addition to this information, Part II deals with information on production practices for corn, and in Part III information is presented on oat production.

It is hoped that the information presented in Part I of this publication will be useful in helping farmers of Mississippi plan a grain production program that will result in additional grain produced on individual farms and in the state as a whole. After the grain production program has been planned it is suggested that a study of Parts II and III of this publication should prove helpful in successfully carrying out a grain production program on Mississippi farms.

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*Jointly representing Mississippi State Vocational Board and Mississippi Agricultural Experiment Station.

Part I

Comparison of Corn and Oats

Corn and oats are the most important grain crops produced in Mississippi, both of which are used largely in feeding livestock. In planning a grain production program a number of factors should be considered. Probably the most important of these factors are: (1) a comparison of the yield per acre of corn and oats in bushels, in pounds, and in pounds of total digestible nutrients, commonly referred to as T.D.N.; (2) a comparison of the labor requirements in producing corn and oats; (3) a comparison of the feeding value of corn and oats; and (4) consideration of the machinery requirements in producing corn and oats.

A Comparison of Corn and Oat Production on Mississippi Farms

To make a comparison of the yields of corn and oats, the need for information other than available experimental and other types of information, was keenly felt. Therefore, it was thought advisable to secure information by a survey method on the production of corn and oats, securing information directly from farmers in Mississippi. In making this study on corn and oat production, the state was arbitrarily divided into five areas: (1) Delta, (2) Brown Loam, (3) North Mississippi, (4) South Mississippi, and (5) Prairie. The map in figure 1 shows the divisions and areas included in each of the sections. These divisions were made to accord with differences in types of farming, so that more specific information might be applicable to each area.

This information was secured by making farm surveys. Communities were selected in different locations in each area and the assistance of vocational agriculture teachers was secured in making the farm surveys. The farm surveys include information on production practices used by farmers on both corn and oats. Three groupings, made for the purpose of comparing yields of corn and oats on these farms, were set up on the basis of corn yields: group 1, farms having low corn yields; group 2, farms having medium corn yields; and group 3, farms having high corn yields. After the groupings were completed, the average corn yield was computed for each group; then the average yield of oats was computed on the farms that were placed in the low, medium, and high groups, which gives a comparison of the yield of corn and oats on the same farm for each of the groups.

In each area the following information is shown: (1) number of farms, (2) acreage of corn and oats, (3) amount of fertilizer used per acre, (4) actual pounds of plant food applied per acre, and (5) yield per acre in bushels, pounds, pounds T.D.N., and pounds of protein. The results of this grouping by areas are shown in tables 1, 3, 5, 7, and 9. Table 11 shows an average of the five areas for the State of Mississippi.

The chief aim sought in making the farm surveys on corn and oat production was to get yield figures on each of these crops that could be used by farmers in determining which one or what combination of the two to produce as a source of grain for food and feed on their farms. In addition to the yield figures information on the more significant practices which might cause variation in yields was obtained. These practices were such as seedbed preparation, kinds and amount of fertilizer used for corn and oats, and rates of seeding oats. While this information on these practices is presented primarily in the nature of supplementary information to the comparison of yields for corn and oats, it may throw some light on determining the particular method to follow with respect to some of the practices. It is recognized that the scope of the surveys was too small to consider the results from different methods of carrying out a particular practice as a valid guide to a farmer in making a decision as to just what method to use with respect to such a practice. On some of these practices controlled experiments have been conducted in Mississippi and in other states, and the need for referring to the results of these experiments for more dependable guidance in determining the particular methods to use is emphasized at this point. Tabulation of the data showing comparative yields of corn and oats has been set up and is presented in separate tables for each area surveyed; also the data or practices, supplementary to the yield data, are presented separately for each area surveyed and following immediately after the table on comparative yields of corn and oats for each area in tables 2, 4, 6, 8, and 10.

Information was also secured on the crop following oats. A high percentage of the operators of farms surveyed was using hay crops, and yields were reported as ranging from one-half ton to two tons per acre. There is also a possibility that a considerable amount of the corn acreage was interplanted with summer legumes, but this information was not secured in making the farm surveys. If hay were used after oats, and if corn were interplanted with summer legumes and the legumes cut from the corn for feed, there is a possibility of increased production of total digestible nutrients per acre. Due to the lack of information on the amount of corn interplanted, it was thought advisable not to attempt to determine the T.D.N. produced from hay and oats. It is suggested that the advisability of corn interplanted with summer legumes and oats followed by a hay crop should be considered in determining the total T.D.N. produced from land planted to corn and oats.

Delta Area

The Delta area is the largest oat producing area of Mississippi. There were 60 farm surveys made in 12 widely distributed communities in the Delta area. These farms ranged in size from approximately 40 acres in cultivation to thousands of acres. In this area 5-year average results were obtained in most cases. The tabulation for this area give results covering a period of at least 4 years. The results are shown in table 1.

Table 1.—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups in the Delta area.

	No. farms	Acreage	Fertilizer used		Yield per acre			
			Total pounds per acre	Lbs. nitrogen per acre	Bushels	Pounds	Lbs. T.D.N.	Lbs. protein
			Low corn yield group					
Corn	22	2559.0	59.5	9.9	12.5	700	571	49.7
Oats	22	2865.5	183.8	31.4	46.3	1482	1043	143.8
			Medium corn yield group					
Corn	25	6921.0	75.6	14.1	22.3	1248	1019	88.6
Oats	25	4385.0	174.3	31.5	56.5	1808	1273	175.4
			High corn yield group					
Corn	13	2367.0	136.2	27.1	31.5	1764	1441	125.2
Oats	13	1447.8	142.2	27.0	58.1	1859	1309	180.3

The average amount of fertilizer used per acre on corn and oats was determined; the fertilizer consisted largely of nitrate of soda, sulphate of ammonia, and cyanamid.

Table 2.—Practices used in corn and oat production by farms in the Delta area.

Rate of planting oats

Rate of planting bushels	Number farms	Acreage	Lbs. fertilizer per acre	Yield per acre bushels
1½	3	185.0	114.0	44.0
2	6	298.0	175.6	50.0
2½	25	4057.8	175.5	50.1
3	19	3387.5	168.2	50.9
3½	6	900.0	158.8	69.2
4	1	120.0	200.0	58.0
Methods of land preparation for corn and oats				
		Corn		
Bed and disk	11	1305.0	91.2	19.2
Bed and plant in water furrow	9	1310.0	76.8	20.2
Flat break, disk and harrow	12	3077.0	139.0	26.3
Double disk, bed with middle burster and harrow	17	2629.5	139.0	23.8
		Oats		
Double disk and harrow	43	5868.0	170.0	50.0
Flat break and disk	14	2560.3	164.0	56.4
Miscellaneous methods	3	520.0	146.1	49.3

Table 3—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups in the Brown Loam area.

			Fertilizer used		Yield per acre			
	No. farms	Acreage	Total lbs. per acre	Pound N-P-K per acre	Bushels	Pounds	Lbs. T.D.N	Lbs. protein
				Low corn yield group				
Corn	21	2794.0	88.0	13.6-1.1-.2	13.1	733.0	598.0	52.0
Oats	21	878.0	118.0	18.8-0-0	38.6	123.5	870.0	119.7
				Medium corn yield group				
Corn	11	1474.0	104.0	16.1-1.3-.7	19.5	1092.0	892.0	77.5
Oats	11	595.0	108.0	17.2-0-0	42.0	1344.0	946.0	130.0
				High corn yield group				
Corn	11	446.0	153.0	10.5-1.0-4.0	26.6	1489.0	1216.5	105.7
Oats	11	232.0	90.0	15.4-0-0	48.0	1536.0	1081.0	149.0

Table 4.—Practices used in corn and oat production by farms in the Brown Loam area.

Rates of planting oats

Rate of planting bushel	Number farms	Acreage	Lbs. fertilizer per acre	Yield per acre bushels
2	2	882.25	55.6	35.4
2½	13	584.00	136.9	40.2
3	4	90.00	56.3	30.4
3½	2	46.50	122.5	26.0
Methods of land preparation for corn and oats				
		Corn		
Disk, bed with burster	19	2080.00	92.9	18.1
Middleburst and rebed	12	1283.25	103.2	17.5
Flat break and harrow	12	1361.00	88.0	15.2
		Oats		
Flat break and disk	15	365.25	152.9	58.8
Double cut with disc harrow	28	1341.00	103.3	35.6

Brown Loam Area

There has been a considerable increase in the acreage of oats planted in the Brown Loam area during the last three or four years. In making the farm surveys in this area information was secured on a 5-year average basis, or for as many years as oats had been produced provided oats had not been grown for 5 years. There were 43 farm surveys made in 10 communities in the Brown Loam area. The results of the tabulations for the Brown Loam area are shown in table 3. The fertilizer used under corn in the Brown Loam area consisted of a mixture of nitrate of soda, sulphate of ammonia, superphosphate, and complete fertilizer. On oats the fertilizer used was nitrate of soda.

North Mississippi Area

In making the corn and oat production study in the North Mississippi area, 81 farms were surveyed in 18 communities. Farms in this area ranged from very small to relatively large. In this area 5-year average results were obtained where possible. Tabulations for this area shown in table 5 give results covering from a 2- to 5-year period.

The average amount of fertilizer used per acre was computed for corn and oats. The fertilizer used per acre on corn in the North Mississippi area consisted of nitrate of soda, superphosphate, and complete fertilizer. All

Table 5.—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups in the North Mississippi area.

	No. farms	Acreage	Fertilizer used		Yield per acre			
			Total lbs. per acre	Pounds N-P-K per acre	Bushels	Pounds	Lbs. T.D.N.	Lbs. protein
			Low corn yield group					
Corn	24	785.95	124.0	14.2-6.3-1.0	14.3	800	654	57.8
Oats	24	295.50	105.0	16.8-0-0	32.9	1043	735	101.2
			Medium corn yield group					
Corn	38	1421.00	134.0	8.0-0.8-4.4	20.3	1136	928	80.6
Oats	38	657.00	90.0	14.4-0-0	40.3	1290	908	125.1
			High corn yield group					
Corn	19	535.50	209.0	17.8-9.8-4.4	33.6	1881	1536	122.5
Oats	19	288.50	115.0	18.4-0-0	48.1	1510	1063	146.5

Table 6.—Practices used in corn and oat production by farmers in the North Mississippi area.
Rates of seeding oats

Rate of planting bushels	Number farms	Acreage	Lbs. fertilizer per acre	Yield per acre bushels
2	44	506.3	146.0	38.7
2½	22	509.0	130.0	43.0
3	11	167.4	180.0	45.0
3½	1	19.0	135.0	56.5
4	1	12.0	100.0	33.0
Methods of land preparation for corn and oats				
		Corn		
Flat break	34	1375.70	153.0	22.1
Bed two times	27	564.75	152.6	20.5
Flat break and bed	14	563.00	173.7	25.4
Disk and bed	5	219.00	46.5	14.4
		Oats		
Double disk	30	459.40	251.0	41.9
Flat break and disk	21	422.25	110.0	40.1
Flat break	29	344.35	72.0	38.2

groupings in this area were made regardless of type of soil. This fact should be remembered in reviewing the average yield in the North Mississippi area.

South Mississippi Area

Oats have not been produced as extensively in the South Mississippi area as in some other areas of Mississippi as is shown by the relatively small acreage included in this study. There were 48 farms surveyed in the South Mississippi area located in 10 communities. The results in this area cover periods ranging from 1 to 3 years, and are shown in table 7.

The fertilizer used on corn in the South Mississippi area consisted of nitrate of soda, superphosphate and complete fertilizer. Oats were fertilized with nitrate of soda.

Table 7.—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups in the South Mississippi area.

	No. farms	Acreage	Fertilizer used: Total lbs. per acre	Fertilizer used: Pounds N-P-K per acre	Yield per acre: Bushels	Yield per acre: Pounds	Yield per acre: Lbs. T.D.N.	Yield per acre: Lbs. protein
				Low corn yield group				
Corn	8	268.2	180.8	19.4-5.6-2.8	14.3	800	653	56.8
Oats	8	143.5	144.3	23.1-0-0	32.3	1031	726	100.0
				Medium corn yield group				
Corn	24	1719.8	111.0	7.7-3.6-.5	19.1	1069	893	75.8
Oats	24	728.5	99.2	16.0-0-0	32.7	1045	736	101.4
				High corn yield group				
Corn	16	486.0	147.1	12.5-6.6-1.9	28.5	1596	1303	133.3
Oats	16	257.3	112.1	18.6-0-0	44.0	1408	991	136.6

Table 8.—Practices used in corn and oat production by farmers in the South Mississippi area.

Rate of planting bushels	Number farms	Acreage	Lbs. fertilizer per acre	Yield per acre bushels
		Rates of seeding oats		
1½	3	22.0	100.0	27.3
2	15	427.0	100.0	28.9
2½	14	421.0	145.9	39.9
3	15	435.3	151.3	37.1
4	1	20.0	150.0	50.0
		Methods of land preparation for corn and oats		
		Corn		
Bed 2 times	24	1647.2	116.4	26.4
Flat break and harrow	11	2618.0	199.0	24.6
Disk and bed	10	475.5	95.0	24.7
Middleburst and list	2	70.0	200.0	20.0
		Oats		
Double disk	24	750.0	149.9	35.8
Flat break and harrow	25	615.3	104.0	35.2

Prairie Area

In the study on corn and oat production the Prairie area is designated to include the Northeast and Central prairie belts. There were 28 farms surveyed in this area, about equally divided between the Northeast and Central prairie belts. The results of the tabulation are shown in table 9.

The fertilizer used on corn in this area consisted of nitrate of soda and complete fertilizer, while oats were fertilized with nitrate of soda.

Table 9.—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups in the Prairie area.

	No. farms	Acreage	Fertilizer used		Yield per acre			
			Total lbs. per acre	Pounds N-P-K per acre	Bushels	Pounds	Lbs. T.D.N.	Lbs. protein
			Low corn yield group					
Corn	12	1025.0	43.2	6.0-.8-.4	7.4	426	348	30.2
Oats	12	337.2	86.0	13.9-0-0	33.3	1066	750	103.4
			Medium corn yield group					
Corn	10	248.5	87.3	12.3-1.1-.6	20.5	1148	938	81.5
Oats	10	134.0	88.0	14.1-0-0	41.3	1322	931	128.2
			High corn yield group					
Corn	6	298.0	201.5	7.9-2.9-1.4	42.0	2352	1921	166.9
Oats	6	111.0	50.0	8.0-0-0	56.2	1798	1266	174.4

Table 10.—Practices[1] used in corn and oat production by farmers in the Prairie area.
Rates of seeding oats

Rate of planting bushels	Number farms	Acreage	Lbs. fertilizer per acre	Yield per acre bushels
2	15	288.7	82.2	41.0
2½	8	130.5	43.6	43.6
3	4	61.0	112.2	45.0
4	1	102.0	100.0	32.0
Methods of land preparation for corn and oats				
		Corn		
Bed in fall, rebed in spring	2	625.0	12.0	8.8
Disk and bed	7	346.0	60.8	14.8
Bed	12	263.0	87.0	19.6
Flat break	6	147.5	75.9	18.3
		Oats		
Disk and harrow	16	440.1	70.8	36.5
Break and disk	13	142.1	108.4	49.0

Table 11.—A comparison of corn and oat yields on farms grouped according to corn yields into low, medium, and high yielding groups—average for five areas of Mississippi

	No. farms	Acreage	Fertilizer used		Yield per acre			
			Total lbs. per acre	Pounds N-P-K per acre	Bushels	Pounds	Lbs. T.D.N.	Lbs. protein
			Low corn yield group					
Corn	87	7432.15	83.6	11.5-1.5-0.3	12.3	688	562	48.8
Oats	87	4519.70	157.3	26.4-0-0	41.9	1341	944	130.0
			Medium corn yield group					
Corn	108	11784.30	73.27	12.6-1.8-.75	21.2	1187	969	84.0
Oats	108	6499.50	149.5	26.3-0-0	50.0	1600	1307	155.2
			High corn yield group					
Corn	65	4132.50	153.43	20.9-2.3-1.3	31.6	1769	1445	125.5
Oats	65	2336.6	125.96	23.0-0-0	53.3	1705	1392	165.3

Labor Requirements for Corn and Oats

The amount of labor required to produce and harvest any crop has a direct bearing on the cost of production.[2] With a shortage of farm labor it may be necessary to change farm plans to include crops that require less labor and utilize more mechanical equipment.

In planning a grain production program for farms in Mississippi it is felt that a comparison of the total hours required per acre to produce corn and oats should be made, and that the monthly distribution of the total labor

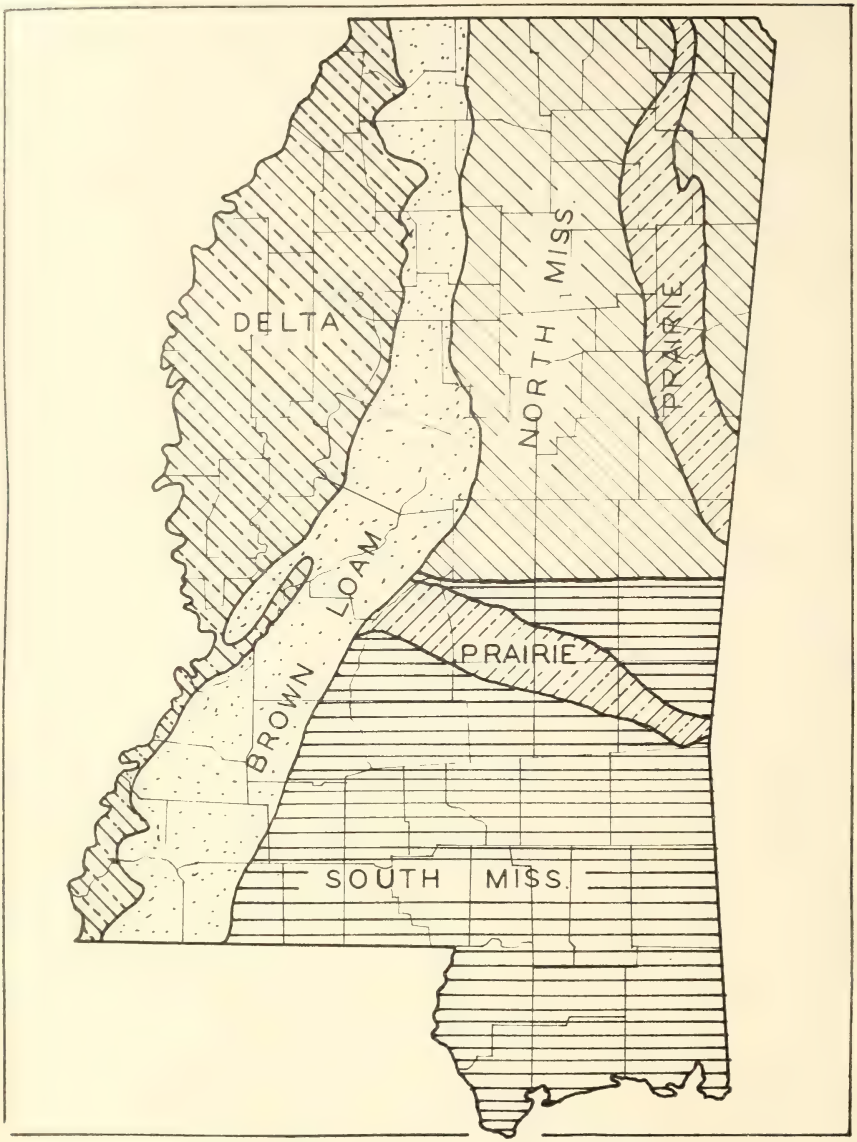

Figure 1.—Map of Mississippi showing division of state into areas.

required should be examined. Cotton is the main cash crop produced in Mississippi, therefore, it is suggested that the monthly distribution of labor on corn and oats should be compared with the monthly distribution of labor for cotton. By making these comparisons the labor peaks by months can be determined for the different crops. It is suggested that a study of this kind should be helpful in planning a farming program that will help to get maximum returns from labor on Mississippi farms. The total amount of labor and the monthly labor distribution for cotton, corn, and oats is shown in figure 2 and table 12.

Table 12.—Total hours labor required for one acre of corn, oats, and cotton, and monthly labor distribution—Mississippi.

	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Dec.	Total
Corn	2.3	5.7	8.2	6.5	5.6	1.0	—	—	2.0	2.7	34.0
Oats	—	1.0	—	3.0	6.0	—	—	2.0	4.0	—	16.0
Cotton	4.0	6.0	12.0	25.0	18.0	4.0	12.0	24.0	12.0	8.0	125.0

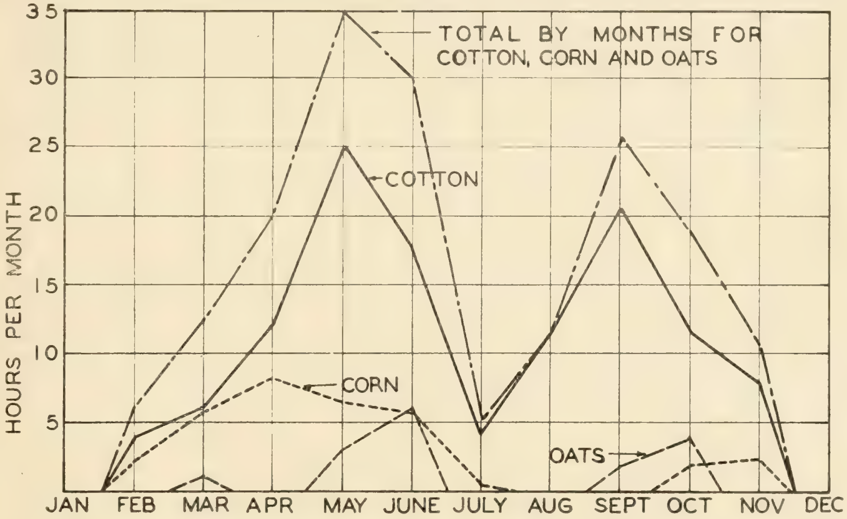

Figure 2.—Labor distribution for cotton, corn, and oats by months.

References: Changes in Technology and Labor Requirements in Crop Production Wheat and Oats, Works Progress Administration, National Research Project.

Changes in Technology and Labor Requirements in Crop Production Corn, Works Progress Administration, National Research Project.

Changes in Technology and Labor Requirements in Crop Production Cotton, Works Progress Administration, National Research Project.

CORN AND OATS AS A FEED FOR LIVESTOCK

In planning a grain-production program it is important to consider the efficiency of the different grains for livestock. Experimental information is presented in this section on the comparison of corn and oats when fed to workstock, beef cattle, hogs, sheep, poultry and dairy cattle.

Corn Versus Oats For Work Mules

Conducted by: Missouri Agricultural Experiment Station.

Conducted at: Columbia, Missouri.

Period: Two 364-day periods; First from March 17, 1909 to March 16, 1910; second from April 6, 1910 to April 5, 1911.

Purpose: The object of this experiment was to secure data concerning the relative efficiency and economy of corn and oats when fed in conjunction with mixed clover and timothy hay to mature mules doing farm work.

Procedure and Conditions: The plan of this experiment was to divide two pairs of mature work mules into two lots in such a manner that one mule in each pair was in each of the lots. It was the plan to work the mules in each pair together and on an evener during the entire experiment in order to insure the performance of an equal amount of labor by each mule in a given team. The mules were used during the experiment to perform farm labor and such hauling and grading as was necessary at the Experiment Station during that time.

The mules in both lot 1 and 2 received mixed clover and timothy hay as roughage. Lot 1 received a grain ration of shelled corn and lot 2 was fed oats as a grain ration. The mules were named and numbered as follows:

The lighter pair: Kate, No. 1, and Beck, No. 2.

The heavier pair: Julia, No. 3, and Mary, No. 4.

Beck and Mary composed lot 1, while Kate and Julia made up lot 2.

The amount of feed fed was governed by the condition and appetite of the animals.

The experiment was conducted as above outlined from March 19, 1909, to March 16, 1910, a total of 364 days, or thirteen 28-day periods. At the close of this 364-day period, the two lots of mules were reversed so that during the second period the mules which had received corn and hay were fed oats and hay, and those which had received oats and hay were fed corn and hay. The time required to make the change was from March 16, 1910 until April 6, 1910. From April 6, 1910 until April 5, 1911, a total of 364 days, lot 1 received oats and hay and lot 2 was fed corn and hay. The experiment was thus divided into two 364-day periods. The above reversal of the lots was made because it was thought that it would tend to eliminate the factor of individuality among the mules. From this plan it is evident that the mules in lot 1 were comparable to those in lot 2 and any difference in them was due to the rations fed.

Mules used: The mules used in the experiment were raised in Missouri and had been used on the University Farm for some time prior to the beginning of this experiment. Each pair was well matched in type, size, quality, and age. The lighter weight mules were "sugar mules," while the heavier pair were draft mules. The lighter pair, No. 1 and No. 2 were about ten years old and had an average weight of 1217 pounds. Beck, No. 2 in lot 1, was not so good a feeder as was her teammate. The heavier pair of mules, Julia, No. 3, and Mary, No. 4, were five years old and had an average weight of 1382 pounds. All the mules started on the experiment in good working condition. Julia, No. 3, was a better feeder than her mate.

Feeds: The feed was purchased at various times and from various sources. Both corn and oats were fed shelled. The grain was purchased from Kansas City firms and was inspected at that point. The corn fed was what is known on the market as No. 2 mixed and the oats were of good average quality. A part of the hay was purchased locally and a part purchased through Kansas City Commission firms. It varied somewhat, but the quality was good. It was mixed clover and timothy and the amount of clover varied from 10 to 25 percent. Since the mules were fed from the same hay, the factor of variation in hay was constant in both lots.

Weights and Records: Accurate weights of all feed offered and refused were kept during both years of the experiment. The two 364-day periods during which the experiment was conducted were each divided into 13 periods of 28 days each. The initial and final weights here presented consist of an average of three weighings taken on consecutive days. The weights for each period consist of an average of single weights taken at the end of each week during the period. Weights of the mules were taken in the morning before the animals had had any water or grain.

Table 13.—Summary of data on corn and hay compared with oats and hay as a ration for mature mules doing farm work, average of two 364-day periods.

Ration	Corn and hay	Oats and hay
Number of mules	4	4
Length of period, days	364	364
Average weight, pounds	1279.16	1258.61
Average loss or gain in weight, pounds	18.5 gain	2.0 loss
Total corn per mule per 364-day period	4142.75 lbs.	———
Total oats per mule per 364-day period	———	4288.5 lbs.
Total hay per mule per 364-day period	5360.31 lbs.	5434.87 lbs.
Hours of heavy labor per mule	433.12	374.75
Hours of medium labor per mule	197.50	188.75
Hours of light labor per mule	1002.12	956.75

Reference: Missouri Agricultural Experiment Station Bulletin 114, pages 5, 6, 7, and 19, table 7, "Corn versus oats for work mules," October 1913, Columbia, Missouri.

A Comparison of Corn and Oats For Feeding Workstock

Conducted by: Kansas Agricultural Experiment Station.

Conducted at: Manhattan, Kansas.

Period: 1911.

Purpose: To find, if possible, a grain or a mixture of grains for horse feeding that would give as good results as oats.

Procedure and Conditions:

Horses Used: The horses used in this experiment belonged to the United States Sixth Field Artillery. They averaged about 1165 pounds in weight and ranged in age from five years up, the average age being about 11 years. There were 937 horses used in this feeding test.

Nature of the work: Nowhere is the work of horses so uniform as in the army, each horse does practically the same kind and the same amount of work. The work performed during the experiment in question might properly be classed as rapid light draft. It consisted chiefly of marching and drilling, the horses being hitched to heavy wagons and guns. A considerable portion of the work was done at a trot and no small amount at a gallop. While the artillery horse performing his regular duties did not work so many hours a day as the farm horse during the busy saeson, yet the work done was extremely fatiguing and more severe than the average work done by the farm horse through the year.

Weighing: The horses were weighed individually at the beginning of the experiment and at the end of each 30-day period. Accurate records were kept of the weights.

Sick Report: A careful sick report was kept. All horses off their feed for more than 48 hours or prevented by illness or injury from performing their regular duties for a like period of time, were eliminated in calculating results.

Digestive disturbances were reported from the following lots:

Lot 1. One case of colic; mild.
Lot 2. Three cases of colic; mild.
Lot 3. One case of colic; mild.
Lot 5. One case of enteritis; fatal.

Method of Feeding: The horses were fed at 5:30 and 11:30 o'clock in the morning and 5:30 in the afternoon. All lots reported here were fed one-third of the grain allowed at each meal and all of the hay at night. When a ration was of different grains they were thoroughly mixed before feeding.

During the early part of the experiment—January and February—while the weather was cold and the work only moderate, there was apparently no difference between the corn-fed and the oats-fed horses. The horses receiving corn did their work and maintained their weight and condition just as well in every respect as the horses receiving oats. But as the weather grew warmer and the work more severe, the corn-fed horses in lot 2 gradually began to lose weight, and at the end of the experiment had lost 29.3 pounds to the horse.

Table 14.—A comparison of corn and oats by feeding workstock.

	Lot 1	Lot 2	Lot 3	Lot 5	Lot 11
	Oats prairie hay	Corn prairie hay	Oats 2/3 corn 1/3 prairie hay	Oats 1/3 corn 2/3 prairie hay	Oats prairie hay
No. Horses	76	76	74	69	18
No. days fed	140	140	140	110	140
Average initial weight (lbs.) Jan. 15, 1911	1131	1181	1185	1197	1182
Average final wt. (lbs.)	1147	1152	1172	1183	1163
Average gain or loss in wt. (lbs.)	16	—29	—13	—13	—19
Average age of horses	9.35	8.34	10.44	11.0	14.0
Grain daily per 1000 lbs. live wt. (lbs.)					
Oats	10.5	...	6.8	3.4	10.3
Corn	..	10.3	3.4	6.7	.
Hay daily per 1000 lbs. Live weight (lbs.)					
Prairie*	12.2	12.0	12.0	12.0	12.0
Digestible protein per day per 1000 lbs. live wt. (lbs.)	1.5	1.2	1.3	1.2	1.5
T.D.N. per day per 1000 lbs. live wt. (lbs.)	12.6	13.8	12.7	13.1	12.3

*Prairie hay is wild hay.

Reference: Kansas Agricultural Experiment Station Circular 62, pages 2, 3, 4, 12, and 13, table 6, November 1917, "Feeding Work Horses," Manhattan, Kansas.

Comparison of Corn, Oats, and Barley For Fattening Beef Calves

Conducted by: Mississippi Agricultural Experiment Station.
Conducted at: State College, Mississippi.

Period: 170 days beginning November 13, 1940 and ending May 2, 1941.

Procedure and conditions: A group of 36 steer calves of choice, good and medium grades were used in this test. The three rations fed were similar except that corn was used as the principal concentrate in one ration while oats and barley were the principal concentrate in the two other rations respectively.

The 36 calves were divided into 3 groups of 12 in each group. All calves were fed in individual stalls, a careful record being kept of the food consumed by each calf. The calves were weighed on three consecutive days at the beginning and end of the feeding period and every 28th day during the progress of the test.

Table 15.—A comparison of Delta oats and barley with corn for finishing calves (170 days) 1940-1941.

	Lot 1 (Corn)	Lot 2 (Oats)	Lot 3 (Barley)
Number of calves per lot	12	12	12
Average initial weight (lbs.)	430	429	429
Average final weight (lbs.)	740	655	703
Average total gain on feed (lbs.)	310	226	274
Average daily gain (lbs.)	1.82	1.33	1.66
Average daily ration (lbs.)			
Ground corn	8.34	------	------
Ground oats		6.18	
Ground barley			7.22
Cottonseed cake	1.99	1.96	1.99
Sorghum silage	5.88	5.39	5.78
Lespedeza hay	1.99	1.00	1.50
Oystershell flour	.10	.10	.10
Av. amount of concentrates per lb. of gain	5.67	6.12	5.71
Slaughter data			
Av. dressing percent	58.98	56.15	57.11
Av. carcass grade	Good	Medium plus	Good

Reference: Mississippi Agricultural Experiment Station Information Sheet 246, "A Comparison of Delta Oats and Barley with Corn for Finishing Beef Calves," June 1941, State College, Mississippi.

Comparison of Corn, Oats and Barley in Feeding Pigs

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: January 8, to April 13, 1941.

Procedure and Conditions: Due to the increased acreage of oats and barley it was felt that information should be secured to determine the value of Mississippi grown oats and barley as a substitute for corn in fattening pigs. A feeding trial was conducted at the Mississippi Experiment Station involving 4 lots of 10 pigs each. All pigs were raised on the station farm and were handled similarly until the feeding trial started.

Tankage was the protein supplement used for all 4 lots. Lot 1 was fed corn as a grain feed, lot 2 was fed on Mississippi grown oats, lot 3 was fed corn grown in the corn belt states and lot 4 was fed on Mississippi grown barley.

Table 16.—Feeding corn, oats, and barley to pigs, Jan. 8 to April 13, 1941.

Ration self-fed:	Lot 1	Lot 2	Lot 3	Lot 4
Until pigs reached an average of 100 pounds each.	Ground corn 85 tankage 15	Ground oats 93 tankage 7	Ground oats 93* tankage 7	Ground barley 89.9 tankage 10.1
From 100 pounds average live-weight until finished.	Ground corn 90 tankage 10	Ground oats 97.7 tankage 2.3	Ground oats 97.7* tankage 2.3	Ground barley 95.3 tankage 4.7
Grazing:	Oats	Oats	Oats	Oats
Number of pigs	10.0	10.0	10.0	10.0
Average initial weight, lbs.	65.39	65.46	65.86	66.19
Days on feed	80.0	96.0	96.0	80.0
Average daily gain, lbs.	1.91	1.46	1.52	1.69
Average final weight, lbs.	218.86	206.26	212.53	201.52
**Mineral consumed per 100 lbs. gain	1.01	2.34	2.25	1.36
Feed consumed per 100 lbs. gain	389.66	489.41	459.95	375.37

*Lot 2 was fed Mississippi-grown oats, weighing 36¼ pounds per bushel. Lot 3 was fed commercial oats weighing 34½ pounds per bushel.

**Minerals self-fed to all lots consist of mixture of 10 pounds oystershell flour and one pound salt.

Reference: Mississippi Agricultural Experiment State Information Sheet 245, "Feeding corn, oats and barley to pigs," June 1941, State College, Mississippi.

Comparison of Corn and Oats For Growing and Fattening Pigs

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: From 1920's to 1930's.

Purpose: To secure information on various feeds as complete or partial substitutes for corn in swine feeding.

Procedure and Conditions: In the tabulation given in table 17 a number of experiments conducted at the Ohio Agricultural Experiment Station are summarized. They were conducted over a considerable period of time, beginning in the 1920's and running up into the 1930's. The pigs were not fed in the same way through the different experiments; some were self-fed and others were hand-fed. All experiments were conducted in dry lots.

Comparison of Rations For Laying Hens Including Corn and Oats, Whole, Hulled, Ground and Germinated

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: 1922-1928.

Purpose: The purpose of tests 1 and 2 was to determine the advantage or disadvantage of replacing a part of the yellow corn by oats, and to determine which method of feeding oats and which form of oats might prove most effective.

The purpose of test 3 was to secure further data on germinated oats and to see how much oats could be fed without ill effects.

Procedure and Conditions: It is obvious from the results in table 18 that the oat rations, regardless of the form of oats used or the method of feeding, proved decidedly superior to the yellow corn rations without oats for egg

Table 17.—Comparison of corn and oats for growing and fattening pigs.

	Corn supplement	Barley supplement	Oats supplement	Ground hulled oats supplement	Ground corn, oats supplement	Ground corn, ground hulled oats supplement
No. of comparisons	25	5	8	7	6	4
Pigs at start	229	45	75	50	61	38
Initial wt. per pig lbs.	54.4	55.8	53	50.9	58	58.7
Pigs at close of test	214	45	73	44	60	37
Final wt. per pig lbs.	200.8	204.4	199.0	202.0	204.0	201.3
Av. daily gain lbs.	1.10	1.12	.96	1.19	1.14	1.15
Days required to gain 160 lbs.	145	143.0	167.0	135.0	141.0	140.0
Daily feed per pig lbs.						
Corn	3.77	—	—	—	3.04	3.92
Barley	—	4.09	—	—	—	—
Oats	—	—	4.35	—	1.08	—
Ground hulled oats	—	—	—	3.57	—	.85
Tankage	.38	1.22	.18	.16	.39	.36
Linseed meal	.12	.08	.05	.05	.12	.09
Ground alfalfa	.12	.09	.12	.11	.15	.14
Minerals	.05	.04	.06	.06	.07	.07
Total	4.45	4.52	4.76	3.95	4.94	4.55
Feed per 100 lbs. gain lbs.						
Corn	340.67	—	—	—	274.92	264.88
Barley	—	226.26	—	—	—	—
Oats	—	—	453.10	—	94.96	—
Ground hulled oats	—	—	—	300.70	—	73.65
Tankage	34.22	20.22	18.65	13.50	39.79	31.16
Linseed meal	11.03	6.92	5.23	3.73	10.33	8.16
Ground alfalfa	11.15	7.76	12.83	9.50	12.99	11.87
Minerals	5.36	3.36	6.01	4.97	6.34	5.88
Total	402.45	404.52	495.82	332.40	433.33	395.60

Reference: Ohio Agricultural Experiment Station Bulletin 607, "Substitutes for Corn for Growing and Fattening Pigs." pages 5, 7, 15, 17, 19, and 29, tables 1, 2, 7, 8, and 9, Wooster, Ohio, September 1939.

production. The germinated oats yielded the best results for hatchability of eggs. The rate of mortality of the various groups was practically the same. The hulled oat ration was most efficient from the point of egg production and feed consumption, but this was discounted when the extra cost of hulled oats was taken into consideration. The increased feed consumption of the whole oats (ground) rations is accounted for by the extra fiber of oat hulls which is indigestible and the greater egg production of the groups receiving the oat rations. Moreover, these tests gave no evidence to support the contention that corn is superior to oats for the maintenance of the body weights of layers. In fact, the layers which received the oats ration weighed slightly more, despite the fact that they laid more eggs.

The total rations fed had been consisting of 70 percent yellow corn. This test gives a comparison of other rations consisting of different percentages of corn with the deficiency made up of oats.

Table 18.—Layers as affected by oats versus corn rations by different methods of feeding oats.

Basal ration* plus	Eggs per bird		Feed consumption per bird 50 weeks	Average weight of birds****	Hatchability of fertile eggs*****
	Test	Total 50 weeks			
Oats ground 20)	1	128	68.7	3.38	57.7
Yellow corn** 50)	2	153	71.1	3.25	58.8
Average	—	140	69.9	3.32	58.3
Whole oats 20)	1	130	69.5	3.47	—
Yellow corn** 50)	2	137	68.5	3.21	—
Average	—	133	69.0	3.34	—
Germinated oats*** 20)	1	118	69.9	3.33	77.6
Yellow corn** 50)	2	152	71.9	3.30	66.3
Average	—	135	70.9	3.32	72.0
Hulled oats 12)	1	126	57.0	3.35	—
Yellow corn** 58)	2	136	64.3	3.31	—
Average	—	131	60.6	3.33	—
)	1	102	60.6	3.22	62.3
Yellow corn***)	2	130	64.0	3.23	54.3
Average	—	116	62.0	3.23	58.3
1930-1931					
Oats ground 20 percent	3	120	65.0	3.23	84.0
Oats ground 20)					
Whole oats 20)	3	121	66.1	3.32	80.0
Yellow corn** 15)					
Germinated oats*** 20)					
Yellow corn** 35)	3	137	71.8	3.30	83.0

*Basal ration (all mash) for tests 1 and 2 composed of: coarsely ground wheat 20, meat scraps medium (50-55 percent protein) 10, bone meal 2, salt 0.5, cod-liver oil 1, and free choice of oyster shells and chopped alfalfa hay.

Basal ration (all mash) for test 3 composed of: coarsely ground wheat 20, wheat bran 7, meat scraps 8, dried milk 5, alfalfa leaf meal 5, salt 0.5, cod-liver oil 1, and free choice oyster shells, grit, and chopped alfalfa hay.

**Coarsely ground.

***As dry oats before germination.

****Monthly individual weight of birds.

*****Averages of 11 different hatches January to June.

Reference: Ohio Agricultural Experiment Station Bimonthly Bulletin Volume 21, No. 181, pages 95 and 96, table 1, July and August 1936, Wooster, Ohio.

A Comparison of Shelled Corn and Whole Oats For Lambs

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 1929-1932.

In the fall of 1929 the lambs were fed for 100 days, from October 2, 1929, to January 10, 1930. The feeding period in the fall of 1930 was 90 days, from October 1, 1930 to December 30, 1930. In 1931 the lambs were fed 80 days from October 6, 1931 to December 25, 1931.

Purpose: To determine the relative value of oats and corn as a feed for lambs.

Procedure and conditions: Nine lots of 25 lambs each were fed different rations. One test was started October 2, 1929 and concluded January 10, 1930, another test started October 1, 1930 and concluded December 30, 1930. The third test was started October 6, 1931 and closed December 25, 1931. The lambs used in the first two experiments were grade Rambouillet wether lambs. They were received from the Stock Experiment Station, Miles City, Montana. The lambs in the third test were black-faced range lambs from the state of Washington.

There were enough lambs in each shipment to make it possible to divide all lots uniformly with reference to type, weight, condition, thrift, and quality.

Methods of feeding: All lots were hand fed at 4:30 P. M. and 6:00 A. M. Concentrates were fed in such quantities as the lambs readily ate. Seven parts of shelled corn were fed to one part cottonseed meal. The same total amount of protein was fed in all other lots that received cottonseed meal. Corn silage and clover hay were fed in such quantities as the lambs would readily consume.

After the lambs became accustomed to salt it was kept before them at all times. When they were first put on feed a handful of salt for every 25 lambs was scattered over the clover hay twice a day. Fresh water was before the lambs at all times except during periods when the water froze quickly in the tubs. On such days they were given access to water one hour in the morning and one hour each evening.

Rations: Lot 4—Shelled corn, corn silage and clover hay.
Lot 5—Whole oats, corn silage and clover hay.
Lot 7—Shelled corn, cottonseed meal, corn silage and clover hay.
Lot 8—Whole oats, cottonseed meal, corn silage and clover hay.

Equipment: These lambs were fed in the same shed that has been used for the past 20 years in experimental lamb feeding at this station. Each lot of 25 lambs had access to a space 14x16 under an open shed, facing the south, and a similar area in an open lot extending outside the shed. The lambs were fed concentrates in small flat-bottomed troughs. They were fed roughage in a combination hay and grain rack. Salt was supplied in salt boxes, and water was given in galvanized tubs.

When the lots became muddy they were bedded with wheat straw.

Table 19.—Comparison of shelled corn and whole oats, 3-year average

Ration	Lot 7	Lot 8	Lot 4	Lot 5
	Shelled corn cottonseed meal corn silage clover hay	Whole oats cottonseed meal corn silage clover hay	Shelled corn corn silage clover hay	Whole oats corn silage clover hay
No. lambs in lot	25	25	24.67	25
Av. initial weight	66.39 lbs.	66.57 lbs.	66.66 lbs.	66.72 lbs.
Av. final weight	89.84 lbs.	91.75 lbs.	86.59 lbs.	88.05 lbs.
Av. gain	23.46 lbs.	25.17 lbs.	19.93 lbs.	21.33 lbs.
Av. daily gain	.261 lbs.	.280 lbs.	.221 lbs.	.237 lbs.
Av. daily feed:				
Concentrates	1.23 lbs.	1.73 lbs.	1.05 lbs.	1.61 lbs.
Silage	1.06 lbs.	.864 lbs.	1.06 lbs.	.864 lbs.
Hay	.996 lbs.	.677 lbs.	.976 lbs.	.676 lbs.
Feed per pound gain:				
Concentrates	4.72 lbs.	6.19 lbs.	4.72 lbs.	6.79 lbs.
Silage	4.08 lbs.	3.09 lbs.	4.79 lbs.	3.64 lbs.
Hay	3.82 lbs.	2.42 lbs.	4.41 lbs.	2.85 lbs.

Reference: Indiana Agricultural Experiment Station Bulletin 360, "Fattening Western Lambs," pages 4, 5, 6, 7, and 9, table 1, April 1932, Lafayette, Indiana.

Comparison of Corn and Oats For Milk Production

Conducted by: Massachusetts Agricultural Experiment Station.

Conducted at: Amherst, Massachusetts.

Period: October 16, 1909-May 6, 1910.

Purpose: To compare corn and oats as a feed for producing milk.

Procedure and conditions: This experiment consisted of taking four cows and dividing them into two groups of two each. In the first half of the trial two of the cows received the so-called oat ration, at the same time the other two cows were receiving corn meal ration. In the second half of the trial the rations were reversed. The experiment was duplicated three times. Each period lasted 28 days with an interval of seven days between each experiment and each half. Rations fed consisted of fine grade hay, ground oats, corn meal and bran of average quality. The results of the experiment are shown in table 20.

Table 20.—Comparison of corn and oats for milk production

	Corn meal ration	Oat ration
Number cows	2	2
Average daily feed consumed (lbs.)		
Hay	19.07	19.05
Bran	3.12	3.14
Corn meal	4.5	—
Oats	—	4.48
Total milk, average three 28-day tests (lbs.)	2148.4	2131.5
Av. lbs. milk produced per cow per day	38.3	38.1

Reference: Massachusetts Agricultural Experiment Station Twenty-fifth Annual Report, Part 1, pages 143, 144 and 148, January 1913, Amherst, Massachusetts.

MACHINERY FOR HARVESTING CORN AND OATS

There is considerable variation in the machinery required to harvest corn and oats in Mississippi. Very little machinery is required to harvest corn, while some type of mechanical harvesting machinery is necessary if oats are to be used for grain.

The oat producer has two choices in securing equipment for harvesting oats. They are: (1) ownership of harvesting machinery, and (2) contracting for custom harvesting.

The farm surveys reveal that Mississippi farmers are using the following machinery in harvesting oats: (1) mowing machine with reaping attachment, (2) binder and threshing machine, and (3) combines. These machines are illustrated in figures 3, 4, 5, 6, 7, and 8. In practically all cases where the mowing machine with reaping attachment was used, threshing was done on a custom basis. This type of machine was used on the small farms. In a number of cases where the binder was used the threshing was done on a custom thresher. There is considerable variation in sizes of combines that are used, the sizes varying from combines with 40-inch cutter bars to those

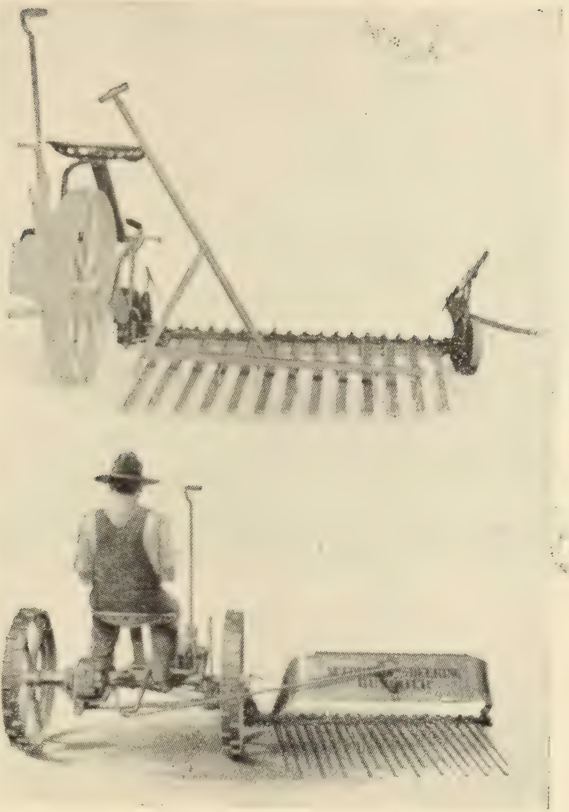

Figure 3.—Mowing machine with reaping attachment.

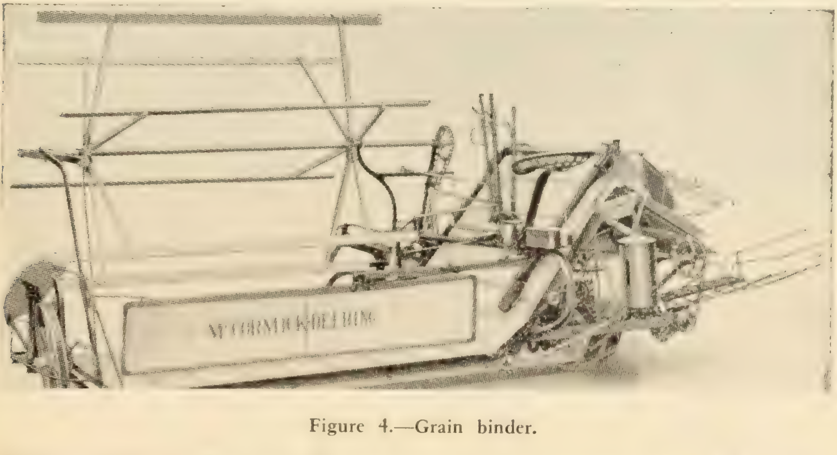

Figure 4.—Grain binder.

having a 12-foot cutter bar. A comparison of the relative cost of the different machines used in harvesting oats is shown in table 21.

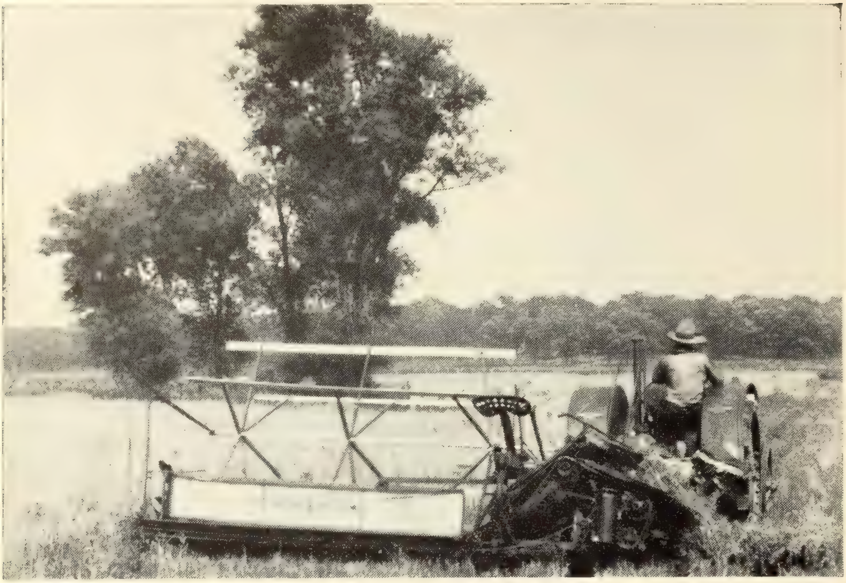

Figure 5.—Grain binder cutting oats.

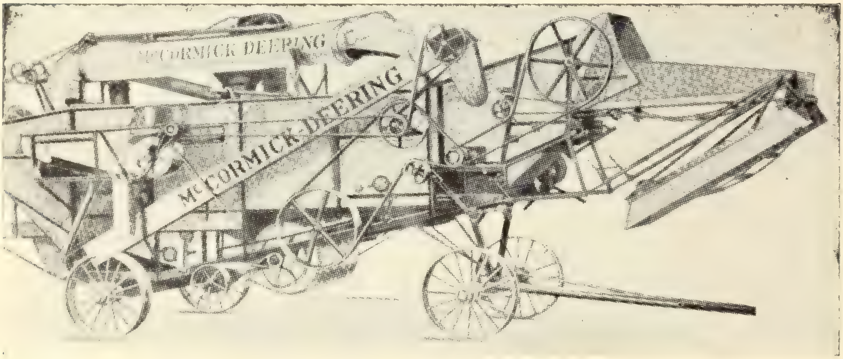

Figure 6.—Grain thresher.

The size of farms producing oats varies considerably. The farms may be classed in three groups: (1) small farms, or 1- to 2-horse farms; (2) medium size, or 2- to 6-horse farms; and (3) large farms. It would hardly be practical for the operator of a small farm to own a combine or binder and threshing machine for harvesting oats, due to the small acreage planted. Because of the total cost of the machinery and the power operation, the small farms must of necessity either own a mowing machine with bundler attachment and hire the oats threshed with a custom thresher, or hire the oats harvested with a combine or binder and threshing machine. The custom charge for harvesting oats has been rather high. There may be a question as to whether the small producer can pay the custom price and still produce oats economically. In some communities small land owners are purchasing combines on a

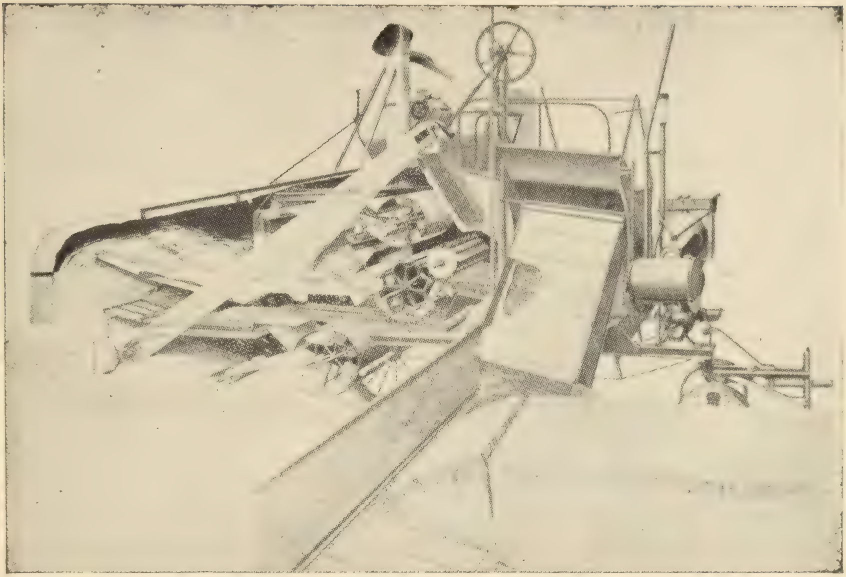

Figure 7.—Sectional view of grain combine.

Figure 8.—Combine cutting grain.

cooperative basis, which tends to reduce the capital investment per farm and per acre and insures a means of harvesting oats at a much lower cost. It may not be practical for many farmers with medium size farms to own individual harvesting equipment. Farmers of the medium-size group may save a great deal on the harvesting cost by purchasing harvesting equipment on a cooperative basis also. Most large farms plant, or can plant, a considerable acreage of oats, and in such cases it may be practical for each farm to have its own harvesting equipment. In most cases the large farms use combines for harvesting. Combines are being used more than any other machine for harvesting oats.

There are some advantages in using the combine over the other methods of harvesting. The purchase price of the small or medium size combine is much less than the cost of a binder and threshing machine. The labor required to operate a combine is much less than the labor required to operate either the mowing machine with reaper attachment or the binder and threshing machine. Oats must be harvested during the labor peak in cotton production, therefore, the matter of saving labor is quite important. Oats harvested with a combine are usually of better quality than oats harvested with a binder and threshed later. Every farmer should plan and provide some means of harvesting oats before attempting to include oats in a grain production program.

Table 21.—Retail prices of oat harvesting equipment*

Horse drawn mower, 4½-foot cutter bar, regular lift, and reaping attachment	$ 130.00
Horse drawn mower, 5-foot cutter bar, regular lift, reaping attachment	132.00
Six foot horse drawn grain binder with bundle carrier and 4 horse hitch	233.00
Eight foot tractor drawn binder, with bundle carrier and tractor hitch	390.00
22" x 38" grain thresher with hand feeder and rake stacker	970.00
22" x 38" grain thresher with self-feeder and wind stacker	1182.00
22" x 38" grain thresher with self-feeder and wind stacker and weigher	1279.00
4-foot combine with flail cylinder; 12-bushel grain tank or bagging attachment; tractor hitch	492.00
4-foot combine with rasp bar cylinder, 12-bushel grain tank or bagging attachment, and tractor hitch	512.00
6-foot combine, power drive, with 25-bushel grain tank or bagging attachment	805.00
6-foot combine, engine drive (complete with engine) 25-bushel grain tank or bagging attachment	1030.00
12-foot combine, 6 cylinder auxillary engine, 45 bushel grain or bagging attachment	1723.00

*Prices based on 1942 retail price quotations.

Part II

Corn Production

Corn is one of the most important crops produced in Mississippi, ranking second only to cotton. The average yield of corn per acre is very low, and as a consequence Mississippi fails by a great deal to produce the amount of grain that is used in the state.

In many instances the cost of producing an acre of corn is as much as, or is more than, the value of the corn produced. Corn responds very well to improved practices, and in view of the relatively low yields and the need for more grain, improved practices in producing corn should be used as much as possible in Mississippi. Rainfall is often the principal limiting factor on the yields of corn. There may be a possibility of helping to overcome the grain shortage in Mississippi by switching certain soils from corn production to the production of other grains that will produce satisfactory yields before a deficiency of rainfall or moisture becomes a problem.

An attempt is made in this publication to present information that will be helpful in improving the corn yields of Mississippi. The information pre-

Table 22.—Corn variety test at Holly Springs, 1928-38.

Variety	Yield in bushels per acre										
	1928	1929	1931	1932	1933	1934	1935	1936	1937	1938	Av.
Neal's Paymaster	65.5	71.7	62.1	41.7	32.1	65.2	48.5	60.5	66.3	70.0	58.4
Jellicorse	—	—	65.8	31.6	35.7	70.1	50.0	58.6	65.4	61.6	54.8
Cockes Pro. Sta.	70.6	70.0	67.5	39.0	29.9	59.1	39.7	48.2	65.1	62.2	55.1
Mosby, Station	68.3	60.8	62.9	34.8	32.1	47.4	40.9	48.2	75.8	65.5	53.7
College Hybrid 47	67.0	61.2	60.1	44.6	30.4	58.7	38.5	47.8	66.4	61.7	53.6
Hasting's Prolific	60.3	82.4	84.2	30.9	29.0	45.4	30.3	43.4	60.5	54.5	52.2
Yellow Mosby	—	—	—	—	—	—	—	51.1	57.3	57.2	55.2
Mosby, Delta	64.9	63.4	63.7	36.9	30.6	53.6	37.2	44.8	56.5	47.0	49.0
Laguna	58.3	53.2	48.7	44.6	30.8	59.4	34.8	48.1	63.3	55.4	49.7
Thompson's Pro.	—	—	—	—	—	—	—	48.8	54.6	—	51.7
Wright's Pro.	—	—	—	—	—	—	32.8	50.0	56.3	53.6	48.2
Russell-Heckles GD	59.1	37.8	44.8	34.0	28.6	59.0	39.9	55.3	51.2	60.3	47.0
Jarvis	—	—	43.4	33.8	28.9	48.1	37.0	52.4	58.5	52.8	44.4
Wood's Gol. Pro.	—	—	—	34.3	25.1	50.6	37.0	47.3	55.6	43.5	41.9
Wood's Cockes Pro.	—	—	48.8	32.4	25.4	50.0	—	—	—	—	39.2
Marchetti	—	—	—	—	27.6	43.1	36.3	49.9	47.1	47.6	41.9
Whatley's Prolific	—	—	—	—	—	—	—	—	—	49.3	49.3
Surcropper	—	—	—	—	—	—	42.1	52.1	33.7	45.9	43.4
Ferguson's Y.D.	54.0	38.6	27.6	30.6	29.8	61.6	38.1	48.9	35.2	43.9	40.8
Mosby Woodruff	—	—	—	20.3	28.1	43.0	32.7	—	—	—	31.0
Piggott's Red Cob	—	—	—	—	—	—	—	—	42.6	—	42.6
Johnson's Prolific	—	—	—	—	—	—	25.9	33.5	51.0	—	36.8
Yellow Creole	—	—	—	—	—	40.4	23.9	—	—	—	32.1
Yellow Surcropper	—	—	—	—	—	—	—	—	—	36.7	36.7
Average of 9 check varieties	63.1	59.9	58.0	37.5	30.5	56.6	38.7	49.5	60.0	57.8	51.2

The check varieties are: Neal's Paymaster, Cockes Prolific, Mosby Station, College Hybrid 47, Hasting's Prolific, Mosby Delta, Laguna, Golden Dent, R. H., and Ferguson's Yellow Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 6, table 2, March 1940, State College, Mississippi.

sented includes information on corn varieties, methods of seedbed preparation, dates of planting, spacing, fertilizing, and methods of cultivation.

CORN VARIETIES AND HYBRIDS

Corn varieties should be considered in planning a corn production program. There is considerable variation in the yield of different varieties of corn. In view of the low average yield of corn in Mississippi the highest yielding variety should be used on every farm. There is considerable variation in the dates of planting corn due to types of soil and to areas of the state. This variation of dates of planting should be considered in selecting a variety of corn to be used.

Information is presented in this section on corn variety tests conducted in different sections of Mississippi. The tests dealing with standard varieties are tests covering a relatively long period of time. These tests have been discontinued and in their place a series of standard tests with hybrid varieties has been started. The results of one year's work with the standard hybrids variety test is given below. In addition to the corn varieties work given from Mississippi, information has been included on corn varieties from Louisiana and Alabama.

Table 23.—Corn variety tests at Stoneville, Mississippi, 1929-38.

Variety	Yield in bushels per acre										
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	Av.
College Hybrid 47	49.9	20.9	58.1	24.5	20.0	31.4	30.5	42.2	14.7	31.1	32.3
Cockes Pro., Sta.	48.8	12.7	63.5	24.3	21.6	29.1	22.8	47.1	12.2	30.0	31.2
Laguna	48.2	19.8	58.4	26.1	22.2	22.1	23.2	49.0	14.7	26.0	31.1
Mosby, Delta	50.0	16.4	53.0	21.8	22.1	27.7	25.5	53.3	15.6	20.9	30.6
Jellicorse	—	16.0	58.3	27.6	24.4	23.7	24.0	40.7	15.4	26.3	28.5
Mosby, Station	43.4	13.5	53.4	25.1	23.2	24.9	22.6	53.2	16.0	20.4	29.6
Neal's Paymaster	46.0	22.2	54.6	20.0	20.8	29.4	22.4	41.4	12.7	24.4	29.4
Hasting's Prolific	48.2	10.1	61.9	20.2	19.6	19.6	18.3	48.6	13.4	24.9	28.5
Yellow Mosby	—	—	—	—	—	—	—	36.6	16.4	24.5	25.8
Wood's Cockes Pro.	—	—	51.3	15.2	20.3	25.0	—	—	—	—	28.0
Woodruff's Mosby	—	—	—	21.4	19.6	25.4	15.4	—	—	—	20.5
Ferguson's Y. D.	39.0	19.4	41.5	19.5	21.3	26.5	22.7	33.3	13.6	17.6	25.4
Wright' Prolific	—	—	—	—	—	—	18.8	34.0	12.4	25.5	22.7
Surcropper	—	—	—	—	—	—	21.5	35.1	16.8	17.6	22.7
Whatley's Prolific	—	—	—	—	—	—	—	—	—	20.7	20.7
Russell-Heckle GD	40.5	18.5	47.1	14.7	16.6	29.3	16.6	31.9	10.7	17.6	24.3
Wood's Gol. Pro.	—	—	41.1	12.2	16.1	26.1	17.8	33.0	13.7	16.3	22.0
Jarvis	—	16.4	39.5	13.9	15.5	27.2	14.7	33.5	10.6	14.9	20.7
Marchetti	—	—	—	—	14.2	22.5	16.6	31.1	13.6	13.2	18.5
Thompson's Pro.	—	—	—	—	—	—	—	32.3	10.1	—	21.2
Johnson's Pro.	—	—	—	—	—	—	10.8	31.9	10.2	—	17.6
Yellow Surcropper	—	—	—	—	—	—	—	19.1	13.5	20.6	17.7
Piggott's Red Cob	—	—	—	—	—	—	—	—	8.2	15.2	11.7
Yellow Creole	—	6.4	—	—	—	—	—	—	—	—	6.4
Average of 9 check varieties	46.0	17.1	54.6	21.8	20.8	26.7	22.7	44.4	13.7	23.8	29.2

The check varieties are: College Hybrid 47, Cockes Prolific, Laguna, Mosby Delta, Mosby Station, Neal's Paymaster, Hastings Prolific, Ferguson's Yellow Dent, and Russell-Heckle's Golden Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 7, table 3, March 1940, State College, Mississippi.

Corn Varieties

Conducted by: Holly Springs, Delta, Raymond, Natchez and South Mississippi Branch Experiment Stations.

Conducted at: Holly Springs, Stoneville, Raymond, Natchez and Poplarville, Mississippi.

Period: 1928-1938.

Purpose: To present information on the comparison of yields of different varieties of corn.

Soils: Holly Springs: Valley.
Delta Branch: Alluvial (sandy loam).
Raymond: Light phase of brown loam.
Natchez: Memphis silt loam.
South Mississippi Branch: Coastal Plain type—not very fertile.

Procedure and Conditions: The tests at the substations give the results of only one planting. Each plot consists of one row approximately 125 feet in length. Each plot was harvested separately, the corn shelled and the yield per acre in bushels was determined. No fertilizer treatment was given the Holly Springs, Stoneville, Raymond and Natchez tests. The variety test at Poplarville is usually fertilized before planting with 400 to 600 pounds of a complete fertilizer and side-dressed with nitrate of soda later in the growing season.

The test at Holly Springs was planted continuously except for 1930.

This variety test was set up at Natchez in 1930. There was no test during 1932 and the very poor stand made the test of no value in 1938.

Table 24.—Corn variety tests at Raymond, Mississippi, 1929-38.

Variety	Yield in bushels per acre										
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	Av.
College Hybrid 47	81.8	39.4	62.3	29.3	56.8	26.7	48.5	51.5	67.9	54.2	51.8
Laguna	78.9	32.1	57.7	30.8	57.8	24.2	49.9	56.4	65.6	50.3	50.4
Neal's Paymaster	72.2	37.0	60.7	19.4	59.1	28.5	48.6	57.6	63.8	51.5	49.8
Jellicorse	—	33.5	54.7	23.9	56.1	29.8	51.3	53.5	63.1	48.0	46.0
Surcropper	—	—	—	—	—	—	55.1	55.2	—	41.5	50.6
Cockes Pro. Sta.	75.4	31.6	61.5	18.4	56.4	25.9	44.7	52.3	66.1	51.7	48.4
Mosby, Station	71.5	25.7	53.6	23.5	54.9	23.0	39.0	55.9	68.3	51.5	46.7
Mosby, Delta	77.3	27.7	55.3	21.2	55.8	26.5	39.3	53.2	—	39.1	43.9
Hasting's Prolific	76.5	31.1	53.5	21.0	51.2	20.8	38.8	54.0	53.8	40.1	44.1
Yellow Mosby	—	—	—	—	—	—	—	50.8	—	42.7	46.7
Russell-Heckles GD	69.3	29.1	44.2	16.7	52.7	25.1	39.0	51.1	52.2	45.9	42.5
Ferguson's Y.D.	74.5	33.2	39.8	12.3	46.8	26.6	45.7	52.3	—	37.5	41.0
Wood's Gol. Pro.	—	—	—	—	49.5	20.8	38.7	52.5	—	41.5	40.6
Johnson's Pro.	—	—	—	—	—	—	32.7	53.5	—	—	43.1
Wright's Pro.	—	—	—	—	—	—	33.3	54.7	—	41.4	43.1
Jarvis	—	31.8	42.7	17.5	48.0	28.6	38.9	52.3	54.6	36.3	39.0
Marchetti	—	—	—	—	—	—	38.2	50.3	—	38.5	42.3
Whatley's Prolific	—	—	—	—	—	—	—	—	—	40.3	40.3
Yellow Surcropper	—	—	—	—	—	—	—	—	—	38.7	38.7
Average for 7 check varieties	75.1	32.3	56.2	22.7	55.6	24.9	44.1	54.1	62.5	49.3	47.7

Check varieties are: College Hybrid 47, Laguna, Neal's Paymaster, Cockes Prolific, Mosby Station, Mosby Delta, and Hastings Prolific.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 8, table 4, March 1940, State College, Mississippi.

Table 25.—Corn variety tests at Natchez, Mississippi, 1930-37.

Variety	Yield in bushels per acre							
	1930	1931	1933	1934	1935	1936	1937	Average
Mosby, Delta	34.2	46.1	51.6	14.7	38.3	51.1	42.0	39.7
Hasting's Prolific	27.3	52.8	47.8	17.0	41.1	56.1	32.1	39.2
College Hybrid 47	31.0	43.5	38.0	13.9	31.2	50.9	49.9	38.3
Mosby, Station	30.1	36.8	40.8	12.7	37.2	50.2	45.6	36.2
Jellicorse	28.0	47.4	34.3	13.5	38.4	50.9	40.5	36.1
Laguna	29.5	45.8	40.9	14.4	32.0	49.5	37.3	35.8
Cockes Prolific, Sta.	28.7	46.0	45.1	14.6	37.2	50.2	22.0	35.0
Yellow Mosby	—	—	—	—	—	40.9	40.6	40.7
Johnson's Prolific	—	—	—	—	34.8	45.1	34.4	38.1
Neal's Paymaster	28.9	42.2	40.4	11.8	36.9	38.7	25.7	32.1
Wright's Prolific	—	—	—	—	31.5	38.8	34.2	34.8
Surcropper	—	—	—	—	28.2	42.1	33.8	34.7
Ferguson's Yellow Dent	28.3	30.6	36.4	10.1	31.0	29.5	38.8	29.2
Wood's Cocke Prolific	—	33.1	34.0	9.4	—	—	—	25.5
Wood's Golden Prolific	—	—	34.9	12.7	27.7	32.4	30.7	27.7
Jarvis Golden Prolific	27.8	35.9	32.6	11.4	25.4	31.4	28.5	27.6
Russell-Heckle's GD	24.8	29.4	29.7	6.4	29.5	30.1	36.3	26.6
Marchetti	—	—	28.8	12.0	27.0	33.7	29.0	26.3
Thompson's Prolific	—	—	—	—	—	15.4	26.8	21.1
Average of 10 check varieties	29.1	42.1	40.5	12.0	36.4	45.7	37.1	34.8

Check varieties are: Mosby Delta, Hastings Prolific, College, Hybrid 47, Mosby Station, Laguna, Cockes Prolific, Neal's Paymaster, Ferguson's Yellow Dent, Jarvis and Russell-Heckle's Golden Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 11, table 5, March 1940, State College. Mississippi.

Table 26.—Corn variety tests at Poplarville, Mississippi, 1929-38.

Variety	Yield in bushels per acre										
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	Av.
College Hybrid 47	37.0	11.2	32.5	23.8	35.2	27.6	43.6	13.5	31.2	28.5	28.4
Jellicorse	—	—	32.5	23.1	37.0	29.8	39.5	17.4	25.0	19.6	28.0
Hasting's Prolific	25.5	10.0	31.9	23.0	26.4	34.4	42.3	16.5	26.8	22.3	27.9
Neal's Paymaster	35.5	14.3	28.9	17.5	32.5	26.3	44.5	14.7	27.6	25.0	26.7
Laguna	37.0	11.9	30.2	26.6	29.0	28.0	37.8	16.9	24.2	25.0	26.7
Russell-Heckle's GD	32.0	16.6	27.4	—	40.2	26.4	40.2	15.1	20.5	22.3	26.7
Mosby Delta	36.5	8.8	32.3	28.6	28.3	31.2	35.7	10.2	25.0	21.4	25.8
Cockes Pro. Sta.	34.5	10.0	32.1	19.6	23.5	32.5	40.6	12.5	27.6	23.2	25,6
Wood's Gol. Pro.	—	—	—	—	33.0	25.4	37.1	15.6	24.2	22.3	26.3
Yellow Mosby	—	—	—	—	—	—	—	17.4	19.4	25.0	20.6
Jarvis Gol. Pro.	—	—	29.3	22.7	34.3	25.9	24.5	17.8	23.2	19.6	25.9
Marchetti	—	—	—	—	32.1	29.8	31.9	15.1	24.2	23.2	26.0
Wright's Prolific	—	—	—	—	—	—	34.4	15.6	22.0	25.0	24.2
Whatley's Prolific	—	—	—	—	—	—	—	—	—	21.4	21.4
Yellow Surcropper	—	—	—	—	—	—	—	—	—	21.4	21.4
Mosby Station	41.0	9.0	31.6	16.6	21.7	27.2	35.7	13.5	28.5	18.7	24.3
Ferguson's Y. D,	27.5	13.3	30.0	19.2	28.1	24.5	23.6	17.8	25.0	19.6	22.9
Johnson's Prolific	—	—	—	—	—	—	36.7	12.0	15.1	—	21.3
Thompson's Prolific	—	—	—	—	—	—	—	15.5	16.0	—	15.7
Surcropper	—	—	—	—	—	—	24.7	16.5	16.0	19.6	19.2
Average for 8 check varieties	35.2	11.7	30.8	22.4	30.5	28.7	38.2	14.5	26.3	23.0	26.1

Checks were: College Hybrid 47, Hasting's Prolific, Neal's Paymaster, Russell-Heckle's Golden Dent, Laguna, Cocke's Prolific, Mosby Delta, Mosby Station, and Ferguson's Yellow Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 11, table 6, March 1940, State College, Mississippi.

Corn Varieties

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1928-1937.

Purpose: To present information on comparison of yields of different varieties of corn.

Soil: Ocklockonee.

Procedure and Conditions: The test at State College was divided into two separate tests, the early test which was planted near the first of April and the late test which was planted the first part of June. The test plots consisted of single rows 125 feet in length with from 4 to 8 replications. Each plot was harvested separately, the corn shelled and the yield per acre in bushels of grain was calculated. No fertilizer treatment was given for these tests.

Table 27.—Early test of corn varieties at State College, 1928-38.

Variety	Yield in bushels per acre										
	1928	1929	1930	1932	1933	1934	1935	1936	1937	1938	Av.
Neal's Paymaster	46.2	62.9	51.0	64.2	39.6	59.3	51.5	50.2	51.4	64.7	54.0
College Hybrid	44.3	59.4	47.9	69.8	48.7	59.4	46.5	47.4	50.0	56.4	53.0
Jellicorse	—	—	46.6	71.4	48.3	59.2	48.9	46.7	44.8	53.7	52.4
Cockes Pro. Sta.	45.8	61.5	47.5	69.6	44.6	56.7	44.6	44.2	46.7	57.2	51.8
Mosby, Station	45.3	57.3	40.9	69.1	45.3	55.9	45.5	43.4	50.1	55.7	50.8
Hasting's Prolific	42.3	60.4	31.4	68.4	51.2	60.0	43.0	41.7	42.5	51.8	49.3
Laguna	40.6	53.1	40.6	62.6	44.2	56.0	44.1	50.1	45.3	50.2	48.7
Surcropper	—	—	—	—	—	—	48.3	47.3	40.0	51.5	46.8
Mosby, Delta	30.9	56.8	35.1	69.0	44.0	57.5	47.9	41.9	40.7	48.0	47.2
Mosby, Woodruff	—	—	—	63.3	41.8	54.4	40.5	—	—	—	50.0
Yellow Mosby	—	—	—	—	—	—	—	45.9	38.5	49.2	44.5
Wright's Prolific	—	—	—	—	—	—	44.1	39.5	40.7	45.9	42.5
Ferguson's Y. D.	32.1	41.3	41.7	51.8	38.9	54.0	49.9	42.6	35.7	52.3	44.0
Russell-Heckle's GD	39.7	43.8	40.7	50.9	38.6	48.6	43.5	42.1	40.1	48.8	43.7
Whatley's Prolific	—	—	—	—	—	—	—	—	—	47.5	47.5
Yellow Surcropper	—	—	—	—	—	—	—	—	—	46.8	46.8
Thompson's Pro.	—	—	—	—	—	—	—	35.3	40.9	—	38.1
Jarvis	—	—	35.6	50.6	33.5	44.6	44.2	35.5	37.6	46.2	41.0
Wood's Gol. Pro.	—	—	—	52.5	33.7	51.2	43.7	45.3	35.7	38.6	41.5
Johnson's Prolific	—	—	—	—	—	—	39.1	32.0	39.6	—	36.9
Wood's Cockes Pro.	—	—	—	55.1	33.0	44.2	—	—	—	—	44.1
Marchetti	—	—	—	—	33.7	40.3	38.2	35.0	35.0	39.5	37.0
Piggot's Red Cob	—	—	—	—	—	—	—	—	32.8	37.0	34.9
Yellow Creole	—	—	—	—	—	40.1	25.0	—	—	—	32.5
Average for 9 check varieties	40.8	55.2	41.9	63.9	43.9	56.3	46.4	44.8	44.8	53.9	49.2

The check varieties are: Neal's Paymaster, College Hybrid 47, Cockes Prolific, Mosby Station, Hasting's Prolific, Laguna, Mosby Delta, Ferguson's Yellow Dent, Russell-Heckle's Golden Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 5, table 1A, March 1940, State College, Mississippi.

Table 28.—Late test for corn varieties at State College, 1928-37.

Variety	Yield in bushels per acre										
	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	Av.
Laguna	48.0	11.4	32.5	53.9	36.1	37.8	50.0	35.7	48.1	50.5	40.4
College Hybrid 47	44.5	7.8	30.2	56.9	39.7	23.3	49.9	32.4	48.9	46.9	38.9
Surcropper	—	—	—	—	—	—	—	34.9	46.8	35.2	39.0
Cockes Pro. Sta.	43.9	4.2	22.9	50.9	28.5	24.5	45.5	27.8	42.0	42.2	33.2
Neal's Paymaster	39.9	3.1	18.8	55.3	27.0	24.1	43.9	29.2	45.7	42.0	33.0
Mosby Station	49.7	1.8	23.4	47.2	27.4	23.2	41.9	24.7	41.2	48.0	32.8
Jellicorse	—	—	22.3	47.0	26.7	21.5	44.3	27.8	44.5	37.3	33.9
Mosby Delta	—	2.9	22.9	36.6	27.4	25.3	41.7	30.5	39.7	36.7	30.4
Hasting's Pro.	48.2	2.4	25.9	50.9	21.9	20.1	46.2	20.6	39.0	37.2	31.2
Yellow Mosby	—	—	—	—	—	—	—	—	40.6	34.2	37.4
Wood's Cockes Pro.	—	—	—	45.8	24.2	20.7	32.7	—	—	—	30.8
Wood's Gol. Pro.	—	—	—	—	23.7	20.2	25.0	20.0	40.5	31.9	28.5
Russell-Heckle's GD	31.7	1.0	14.9	42.4	20.2	20.8	33.2	21.5	47.0	32.6	26.5
Wright's Pro.	—	—	—	—	—	—	—	16.0	38.5	34.9	29.8
Marchetti	—	—	—	—	—	21.7	29.1	21.1	38.8	31.4	28.4
Jarvis	—	—	16.7	39.4	17.7	18.8	31.7	22.9	40.5	29.0	27.1
Johnson's Prolific	—	—	—	—	—	—	—	17.7	31.1	32.6	27.1
Thompson's Prolific	—	—	—	—	—	—	—	—	33.6	28.0	20.8
Ferguson's Y. D.	26.8	1.8	14.9	29.8	14.6	15.1	34.8	17.5	40.1	25.6	22,1
Mosby Woodruff	—	—	—	—	19.1	12.4	33.6	15.0	—	—	20.0
Yellow Creole	—	—	—	—	—	—	31.4	13.1	—	—	22.2
Average of 8 check varieties	41.6	4.2	22.9	48.4	26.9	23.6	43.2	26.2	44.0	40.7	32.2

The check varieties are: Laguna, College Hybrid 47, Cockes Prolific, Neal's Paymaster, Mosby station, Hasting's Prolific, Ferguson's Yellow Dent, Russell-Heckle's Golden Dent.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 5, table 1B, March 1940, State College, Mississippi.

Corn Hybrid and Varieties Tests

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, West Point, Holly Springs, Poplarville, Natchez, Raymond, and Stoneville, Mississippi.

Period: 1941.

Procedure and Conditions: These tests were set up on a uniform basis in 1941 with the tests being conducted at the main station and at the branch stations. In this test 16 hybrids and 4 standard varieties were used.

Each test was made up of six replications; each hybrid or variety occurred strictly at random within each replication. Each plot was two rows wide and varied in length from 12 to 20 hills from one station to another. Each test was check rowed for ease of handling. Fertilizer practices were according to local recommendations and soil needs, and were uniform for a given test. The planting dates are given in table 29.

Table 29.—Corn hybrids and standard varieties test, 7 locations in Mississippi, 1941.

Variety	State College		West Point	Holly Springs	Poplarville	Natchez	Raymond	Stoneville
	Planted Apr. 24	Planted May 28	Planted Apr. 1	Planted Apr. 30	Planted Mar. 27	Planted May 12	Planted **	Planted Mar. 28
Mosby*	56.4	26.8	44.9	58.1	38.7	67.3	51.3	93.0
Tennessee 10	55.5	34.7	47.1	70.2	33.1	67.7	58.1	88.3
Florida W-1	55.3	20.4	42.4	51.3	32.2	61.6	41.0	79.1
National 111-02	55.2	28.9	45.9	55.7	27.6	58.1	51.8	87.8
Louisiana 123	54.1	26.1	43.5	66.2	38.7	65.9	48.3	99.3
Louisiana 3813	53.5	28.2	47.6	64.7	34.6	64.2	53.2	103.1
Louisiana 3802	52.7	23.5	48.8	73.8	39.1	65.3	47.0	91.7
Wood's Golden Pro.	52.7	27.3	47.9	59.2	32.2	55.0	50.7	80.4
College 47*	52.2	25.2	46.9	58.2	35.6	64.2	50.1	81.3
Tennessee 6	51.2	27.0	45.0	59.5	33.8	63.0	51.5	83.4
Funk's G 135	51.0	29.9	45.3	60.6	27.3	54.2	49.3	72.6
Iowealth 302	50.9	24.8	45.7	62.0	30.8	62.2	53.4	80.6
Texas	50.4	33.8	47.3	59.4	27.7	62.4	47.5	67.6
Tennessee 15	49.4	34.8	45.6	61.4	35.5	69.2	59.6	99.6
Funk's G 46	47.8	30.7	45.9	54.7	25.6	54.2	41.8	74.2
U. S. 13	46.4	35.7	45.0	51.5	23.5	51.9	44.0	69.4
Paymaster, Neal's*	46.2	26.2	41.1	69.2	31.8	64.4	51.9	79.2
Tennessee 14	45.9	32.7	41.0	61.7	30.5	62.8	48.7	86.6
Illinois 960	42.7	29.9	42.9	50.8	25.8	55.4	48.7	77.1
Jarvis	38.4	19.2	34.6	45.9	24.9	46.8	32.2	62.7
Average of checks	51.5	26.1	44.3	61.8	35.4	65.3	51.1	84.5

*Check varieties.
**Planting date not given.

Reference: Mississippi Farm Research, December 1941, State College, Mississippi.

Corn Variety Tests

Conducted by: North Louisiana Agricultural Experiment Station.

Conducted at: Calhoun, Louisiana.

Period: 1931-1940.

Purpose: To compare corn varieties.

Table 30.—Corn variety test—Louisiana, 1931-40.

Variety	Bushels ear corn										
	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Av.
Silvermine	8.4	16.4	27.1	15.8	29.8	19.4	34.2	37.0	39.1	43.5	27.1
Surcropper	19.4	22.1	28.9	20.8	31.3	24.3	26.1	39.8	32.4	40.5	28.6
Jarvis Prolific	—	—	30.6	—	14.1	17.9	39.8	36.7	44.1	54.1	33.9
Mosby Prolific	23.3	18.7	—	18.5	40.6	19.5	—	37.8	44.2	56.6	32.4
Hasting's Prolific	25.9	27.0	35.3	21.9	41.4	29.3	44.8	48.9	39.8	69.9	38.4
Cocke's Prolific	24.9	21.5	31.4	22.0	44.2	26.3	43.5	42.5	45.9	63.3	36.5
Calhoun Red Cob	17.8	20.8	31.4	18.5	42.9	21.6	37.3	37.8	43.1	51.0	32.2
Sentell's White Dent	20.9	14.2	31.3	20.6	44.3	23.6	34.6	42.3	39.2	54.1	32.5
Hill's Yellow Dent	18.4	19.1	30.6	23.7	43.9	21.1	38.1	44.1	39.6	45.7	32.4
Tuxpan	—	—	—	20.2	41.4	22.5	39.1	49.7	39.4	45.8	36.9

Reference: North Louisiana Experiment Station Biennial Report 1937-1938, page 14, table 12, Calhoun, Louisiana.

North Louisiana Experiment Station Biennial Report 1939-1940, page 7, table 2, Calhoun, Louisiana.

Corn Hybrid Tests

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, West Point and Stoneville, Mississippi.

Period: 1939-1941.

Purpose: To compare hybrids with standard corn varieties.

Procedure and Conditions: The tests were started in 1939 using three standard varieties and four hybrids. Each plot was replicated six times.

Table 31.—Corn hybrid test—State College, Mississippi, 1939-41.

Hybrid or variety	Bushels per acre 1939	1940	1941	Average
Tennessee 15	38.4	73.7	49.4	53.8
Wood's Golden Prolific	34.2	68.2	52.7	51.7
Mosby*	27.7	66.1	56.4	50.1
Paymaster, Neal's*	34.2	67.5	46.2	49.3
College 47*	31.2	60.3	52.2	47.9
Illinois 960	36.5	62.1	42.1	46.7
Jarvis	24.9	54.6	38.5	39.3
Average of check varieties*	31.0	64.6	51.6	49.1

*Check varieties.

Table 32.—Corn hybrid test—West Point, Mississippi, 1939-41.

Hybrid or variety	Bushels per acre 1939	1940	1941	Average
Illinois 960	26.2	53.1	42.6	40.6
Tennessee 15	17.9	50.8	45.5	38.1
College 47*	12.8	45.9	46.9	35.2
Wood's Golden Prolific	5.5	46.3	47.9	33.2
Neal's Paymaster	5.4	45.4	41.1	30.6
Mosby*	3.1	39.5	44.9	29.2
Jarvis	7.9	37.3	34.6	26.2
Average of check varieties*	7.1	43.6	44.3	31.7

*Check varieties.

Table 33.—Corn hybrid test—Stoneville, Mississippi, 1939-41.

Hybrid or variety	Bushels per acre 1939	1940	1941	Average
Tennessee 15	50.6	75.9	99.6	75.4
Mosby, College*	43.6	69.3	93.0	68.6
Wood's Golden Prolific	40.8	71.2	80.4	64.1
Paymaster, Neal's	38.1	67.0	79.2	61.4
Illinois 960	41.4	60.9	77.1	59.8
College 47*	34.5	61.7	81.3	59.2
Jarvis	37.7	50.0	62.7	50.1
Average of check varieties*	38.7	66.0	84.5	63.1

*Check varieties.

Reference: Mississippi Farm Research, December 1941, State College, Mississippi.

Corn Variety Tests in Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Eight different locations in North and South Alabama.

Period: 1937-1939.

Purpose: To test different corn varieties in North and South Alabama.

Table 34.—Corn variety tests in Alabama, 1937-39.

Variety	Bushels corn per acre									
	South Alabama						North Alabama			
	Auburn	Aliceville	Headland	Brewton	Fairhope	Av	Belle Mina	Crossville	Alexandria	Av.
Hybrid Gol. Pro.	39.1	28.2	32.6	28.2	45.4	34.7	47.1	36.5	37.5	40.4
Douthit (Douthit)	38.9	27.6	36.4	30.7	36.8	34.1	44.9	39.2	41.8	44.0
Neal's Paymaster	35.4	30.9	31.8	28.1	40.6	33.4	49.8	37.3	39.4	42.2
Mosby	36.4	29.3	33.2	29.1	38.5	33.3	45.8	38.3	39.9	41.3
Whatley (Hudson)	39.8	26.4	32.7	29.4	36.2	32.9	40.6	35.2	39.8	38.5
Hasting's Prolific	39.6	29.2	30.4	27.4	37.4	32.8	48.7	34.3	43.5	42.2
Douthit (Marrett)	39.8	25.9	34.9	29.2	34.3	32.8	44.1	38.5	42.6	41.4
Local Variety	39.2	26.6	32.3	28.4	34.9	32.3	42.8	34.6	36.7	38.5
Hasting's super Prolific	37.2	27.8	30.2	27.6	38.1	32.3	47.3	31.9	43.0	40.7
Indian Chief (Sand Mt.)	35.6	28.0	30.6	35.9	40.3	32.1	44.0	34.6	39.2	39.2
Whatley (Whatley Bros.)	37.5	23.8	31.4	30.9	36.5	32.0	39.7	34.2	37.8	37.2
Locker's Yellow	34.4	26.8	30.8	25.3	38.4	31.0	44.0	37.4	40.5	40.6

Reference: Alabama Agricultural Experiment Station Mimeograph, "Results of Corn Variety Tests in Alabama," December 1939, Auburn, Alabama.

Corn Variety Test Northeast Louisiana

Conducted by: Northeast Louisiana Experiment Station.

Conducted at: St. Joseph, Louisiana.

Period: 1937-1940.

Purpose: To compare different varieties of corn under Louisiana conditions.

Procedure and Conditions: The more commonly used varieties grown in this section and some of the most outstanding hybrid strains were used in this test. Planting is usually done about the last week of March or the first of April, the corn being interplanted with soybeans. Fertilizer is used at a rate to give 30 pounds of nitrogen per acre and is applied as a side-dressing when corn is about knee-high.

Table 35.—Corn variety test Northeast Louisiana, 1937-40.

Variety	Bushels ear corn				
	1937	1938	1939	1940	Average
Silvermine	29.5	37.4	39.8	35.8	25.6
Sentell White Dent	37.8	40.6	35.8	47.9	40.5
Calhoun Red Cob	48.7	48.0	35.7	44.7	44.1
Hill's Yellow (from Hill)	—	—	38.9	47.7	43.3
Hill's Yellow (La. Certified)	45.2	52.5	34.2	47.7	44.8
Jarvis	30.8	40.5	36.4	51.4	39.8
Hastings	57.0	51.0	42.9	61.6	53.1
Mosby	31.3	52.2	39.4	56.0	44.7
Cocke's	—	—	41.9	54.1	48.0
Tuxpan White	—	—	35.1	50.8	42.9
Tuxpan Yellow	—	—	31.7	42.0	36.9
Louisiana Hybrid 123	69.8	58.0	48.1	69.8	61.4
Louisiana Hybrid 384	—	—	—	68.4	—
Louisiana Hybrid 3803	—	—	—	65.5	—
Tennessee Hybrid 15	—	—	—	66.7	—
Missouri Hybrid 8	—	—	41.6	44.9	43.2

References: Biennial Report of the Northeast Louisiana Experiment Station 1937-1938, page 17, table 21, St. Joseph, Louisiana.

Biennial Report of the Northeast Louisiana Experiment Station 1939-1940, page 16, table 19, St. Joseph, Louisiana.

METHODS OF SEEDBED PREPARATION

Seedbed preparation is an important item in the cost of producing an acre of corn, in that the amount of labor required to prepare a seedbed by the different methods varies considerably. The corn producer is interested in that method of seedbed preparation which will give the highest yield of corn at the lowest cost per bushel.

Experiment stations have conducted some experiments comparing different methods of seedbed preparation. Some of the results of experimental work are shown in this section. It is suggested that comparison should be made of the results of experiments with practices farmers are using (shown in Part I of this publication) to see if an improvement can be made thereby causing increased corn yields.

Seedbed Preparation and Cultivation Test With Corn at Calhoun, La.

Conducted by: North Louisiana Agricultural Experiment Station.

Conducted at: Calhoun, Louisiana.

Period: 1933-1940.

Purpose: To determine the best method of seedbed preparation and cultivation for corn.

Procedure and Conditions: All methods have had the same fertilization: 250 pounds of 5-9-6 home mixture of nitrate of soda, 18 percent superphosphate, and muriate of potash, applied at planting time.

In the first treatment, corn was planted in the "water furrow," each cultivation raising the level of the row. The last cultivation has been with a turn plow run very shallow and far enough from the row to cut very few roots, but covering all small weeds and grass.

In the second treatment, the corn was planted on level rows and this level was maintained through the last cultivation.

In the third treatment, corn was planted on a bed and kept at the same elevation through the last cultivation.

The first method not only produces more corn but is also the most economical, since less labor is involved. After the corn is thinned, no further hoe work is necessary.

Table 36.—Corn cultivation test, Calhoun, Louisiana, 1933-40.

	Yields in bushels per acre								
Method of cultivation	1933	1934	1935	1936	1937	1938	1939	1940	Av.
Planted in "water furrow," laid by on ridge	10.8	17.1	36.1	16.9	25.5	24.7	35.2	31.2	24.7
Planted on level, cultivated and laid by level	8.1	14.9	28.7	14.1	26.8	23.8	20.2	26.9	20.4
Planted, cultivated, and laid by on ridge	8.4	17.0	37.6	15.9	25.1	21.0	30.4	25.5	22.6

Reference: North Louisiana Agricultural Experiment Station 1937-1938 Biennial Report, pages 14 and 15, Calhoun, Louisiana.

North Louisiana Agricultural Experiment Station Biennial Report, 1939-1940, page 8, table 3, Calhoun, Louisiana.

Method of Preparing Land For Corn

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1937-1938.

Purpose: To determine the best method of preparing corn land.

Soil: Cecil sandy clay loam.

Procedure and Conditions: In this test 1/30 acre plots were used with 4 to 6 replications. Corn was planted on 3½-foot rows, spaced 18 inches in the drill. Corn was planted May 1 to May 15. Hastings Prolific variety was used. No fertilizer was applied to corn. These tests were conducted in a 3-year rotation of corn, small grains and summer legumes, and cotton and winter legumes. Corn planted following Austrian winter peas.

Table 37.—Methods of preparing land for corn, Experiment, Georgia, 1937-38.

Method	Air dry cut to the acre	Shelled corn to the acre
Bedded and planted in water furrow	5,167 (lbs.)	33.3 (bu.)
Land turned planted in shallow furrow	4,656 (lbs.)	28.0 (bu.)
Bedded and planted on top of bed	4,085 (lbs.)	21.4 (bu.)

Reference: Georgia Agricultural Experiment Station Circular 126, "Corn Varieties Hybrids and Cultural Practices," page 11, table 10, March 1941, Experiment, Georgia.

Seedbed Preparation

Conducted by: Nebraska Agricultural Experiment Station.

Conducted at: Lincoln, Nebraska.

Period: 1922-1932.

Purpose: To compare different methods of seedbed preparation.

Procedure and Conditions: During the 11-year period, 1922-32, 13 methods of seedbed preparation were under comparison. In seven of these practices the corn was surface-planted in hills on land that was plowed either in the fall, early spring, or late spring, as specified. In the other six practices, the seed was drilled in open furrows. These were made either by furrow-opener attachments to the corn planter on early-spring plowing, or by listing on land that had either partial preparation in the fall or early spring, or else no previous preparation.

A 3-year rotation of corn, oats, and winter wheat was followed. In the years intervening between the corn crops, the tillage and cropping practices were alike on all plats. The seedbed was prepared for the oats in this rotation by double-disking the corn stubble, and for the winter wheat by plowing the oats stubble 5½ inches deep in July, with subsequent disking and harrowing. In preparation for the planting of corn, the treatments under comparison were as indicated in table 32. As an average for the period, all fall treatments were completed on October 6 and the early-and late-spring treatments on March 29 and May 5, respectively. The corn was grown at the rate of three plants per hill, or its equivalent in the case of drilling. The average planting date was May 8.

Two devices were used for opening furrows: a furrow-opener attachment for the corn planter, and a lister. The furrow openers were used on land plowed seven inches deep in early spring. There were five different types of

Table 38.--The relation of the manner of seedbed preparation to the yield and growth of corn in Nebraska, 1922-1932.

Manner of seedbed preparation*	Yield of shelled corn per acre											
	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	Average
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Surface-planted (checked)												
Early spring plowing												
4 inches	32.0	53.6	29.3	28.9	1.0	43.7	37.4	50.9	2.4	17.5	39.2	30.5
5½ inches	32.2	54.4	29.8	32.2	1.3	46.5	39.0	49.1	2.3	17.5	41.9	31.5
7 inches	39.0	61.8	32.6	33.8	1.1	47.4	34.9	49.7	2.7	21.2	42.0	33.3
10 inches	40.8	62.4	31.0	33.5	0.7	49.9	34.5	51.0	2.8	22.5	39.1	33.5
Late spring plowing:												
7 inches	30.7	54.0	29.8	28.6	1.9	44.6	41.8	52.6	4.5	19.9	41.9	31.8
7 inches preceded by disking	40.5	61.1	32.9	24.4	0.9	45.2	37.1	53.9	2.9	21.3	40.7	32.8
Fall plowing:												
7 inches	32.2	49.9	27.9	19.1	8.5	50.0	28.9	33.7	0.6	13.5	37.2	27.4
Furrows opened ** (drilled)												
7-inch spring plowing early*	34.4	55.5	29.0	26.2	2.4	48.7	35.2	46.0	2.2	20.2	44.4	31.3
Listed (drilled)												
Double listing:												
Fall and spring	36.2	50.4	30.4	31.6	4.6	49.4	39.3	42.9	2.9	13.1	54.8	32.3
Spring	37.8	43.9	31.9	37.6	7.0	49.9	44.6	46.0	6.7	11.0	58.8	34.1
Single listing:												
7-inch fall plowing	32.2	51.3	30.0	27.9	6.3	51.1	31.1	45.5	1.1	12.7	50.8	31.0
Double-disked ground	33.5	42.7	33.3	34.9	10.2	49.6	45.3	46.0	6.7	14.1	56.5	33.9
Hard ground	31.0	45.1	33.9	34.8	7.4	47.7	43.3	43.6	11.7	17.8	55.9	33.8

*All spring-plowed land was harrowed after plowing, and the disk and harrow immediately preceded all surface planting as a measure weed of control.

**Furrows made with a standard furrow opener attachment to an ordinary surface corn planter.

Reference: Nebraska Agricultural Experiment Station Bulletin 293, "Cultural Practices in Corn Production," pages 5, 6, 7, and 8, table 1, January 1935, Lincoln, Nebraska.

listing: (1) double listing in which the first listing was done in the fall and the ridges were listed out in late spring at the time of planting; (2) double listing in which the first was done early in the spring, followed by splitting the ridges at the time of planting; (3) single late-spring listing on 8-inch fall plowing; (4) single late-spring listing on early-spring double-disked ground; and (5) single late-spring listing on ground that received no other preparation than the listing.

DATES OF PLANTING

There is considerable variation in the dates of planting corn in Mississippi. This variation occurs with different type soils, also within areas of the state. It is suggested that in reviewing dates of planting information that this variation in dates of planting should be considered and that experimental information be selected that will apply to the section of the state where it is to be used.

Dates of Planting Corn With Soybeans Interplanted

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1929-1939.

Purpose: To compare the various planting dates for corn.

Procedure and Conditions: Corn was planted on the same land continuous but order of treatments reversed every year. Soybeans were interplanted every year except 1939.

Table 39.—Dates of planting corn with soybeans interplanted—Stoneville, 1929-39.

Dates of planting	Bushels per acre											
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	Av.
March 1	32.1	15.6	29.6	31.3	17.4	26.8	45.7	24.7	31.4	51.2	44.0	31.8
March 15	34.0	16.3	29.3	36.1	18.7	26.7	47.1	15.1	28.3	50.5	45.0	31.5
April 1	30.7	10.4	35.2	34.2	22.1	26.3	43.0	19.2	32.0	45.8	41.7	31.0
April 15	24.3	6.4	35.7	34.2	29.1	25.2	33.1	14.7	33.6	39.9	32.8	28.1
May 1	22.6	5.8	33.9	34.5	26.9	21.4	24.7	16.3	28.1	33.4	32.4	25.5
May 15	25.8	4.3	35.1	41.2	16.6	13.4	21.6	17.9	29.7	32.4	32.7	24.6
June 1	27.5	4.4	37.1	14.5	8.2	17.9	17.3	13.5	29.8	33.0	31.2	21.3
June 15	20.6	0.6	29.2	10.5	8.5	16.6	15.5	9.3	24.3	18.8	25.1	16.3
July 1	13.0	0.0	33.7	6.0	14.0	13.2	22.6	8.0	8.2	9.5	8.4	12.4
July 15	12.9	0.0	24.1	5.4	7.7	4.1	6.9	4.9	9.1	4.6	7.2	7.9

Reference: Mississippi Agricultural Experiment Station Service Sheet 286, "Corn Production in the Yazoo-Mississippi Delta," February, 1940, State College, Mississippi.

Dates of Planting Corn at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Purpose: To determine the best date on which corn should be planted and the variety best suited for planting at different dates.

Period: 1934-1938.

Soil: Fertile Ocklockee loam.

Procedure and Conditions:

Fertilizer: No fertilizer was used.

Size of plots: The three row plots were 1/40-acre in size and the inside row was harvested for data.

Number of replications: Six.

The crops have occupied the same plots each year.

Table 40.—Dates of planting corn—State College, 1934-38.

Year	Yield in bushels grain per acre Date planted*									
	March		April		May		June		July	
	Mosby	Laguna	Mosby	Laguna	Mosby	Laguna	Mosby	Laguna	Mosby	Laguna
1934	—	—	56	47	38	39	35	37	12	26
1935	44	49	46	46	33	34	32	38	2	5
1936	37	36	41	39	36	38	30	36	15	30
1937	36	36	42	40	43	40	34	39	11	20
1938	40	35	41	36	44	43	21	25	2	11
Average	40	39	45	42	39	39	30	35	8	19

*Planted approximately 15th of each month

Reference: Mississippi Agricultural Experiment Station Information Sheet 165, "Planting Dates, Corn and Sagrain," December 1938, State College, Mississippi.

A Comparison of Early and Late Planting of Corn on Bottom Land

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1928-1938.

Purpose: To determine the best time to plant corn.

Soil: Ocklocknee fine sandy loam.

Procedure and Conditions:

Fertilizer: Twenty to thirty pounds nitrogen per acre was applied when the corn was about 10 inches high.

Size of plots: The single row plots were about 1/120-acre in size with six replications.

Spacing: Plants were spaced two to the hill in checks 3½ feet each way.

Cultivation: Cultivation and hoeing were sufficient for weed control.

Table 41.—A comparison of early and late planting of corn on bottom land— Mississippi, 1928-38

Early test	Yield in bushels per acre										
Planted in April	1928	1929	1930	1932	1933	1934	1935	1936	1937	1938	Av.
College Hybrid 47	44	59	48	70	49	59	47	47	50	56	53
Paymaster	46	62	51	64	40	58	52	50	51	65	54
Jellicorse	—	—	47	71	48	59	49	47	45	54	52
Mosby Station	45	57	41	69	45	56	46	43	50	56	51
Laguna	40	53	40	63	44	56	44	50	45	50	49
Hastings	42	60	31	68	51	61	43	42	43	52	49
Cocke's Prolific	46	62	48	70	45	57	45	44	47	57	52
Mosby Delta	31	57	35	69	44	58	48	42	41	48	47
Yellow Dent	—	—	—	—	39	54	50	43	36	—	44
Golden Dent	40	44	41	51	39	49	44	42	40	49	44
Golden Prolific	—	—	—	—	34	51	44	35	36	—	40
Jarvis	—	—	36	51	34	45	44	36	38	46	41
Marchetti	—	—	—	—	34	40	38	35	35	40	37

(Continued)

Table 41.—A comparison of early and late planting of corn on bottom land. (Continued)

Late test Planted first half of June	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	Av.
Laguna	48	11	33	54	36	38	50	36	48	51	40
College Hybrid 47	45	8	30	57	40	23	50	32	49	47	38
Paymaster	40	3	19	55	27	24	44	30	46	43	33
Cocke's Prolific	44	4	23	51	29	25	46	28	42	42	33
Mosby Station	50	2	23	47	27	23	42	25	41	48	22
Jellicorse	—	—	22	47	27	22	44	28	45	37	34
Mosby Delta	—	3	23	47	27	25	42	31	40	37	30
Hastings	48	2	26	51	22	20	46	21	39	37	31
Golden Dent	—	—	—	—	—	21	33	22	47	33	31
Golden Prolific	—	—	—	—	—	20	35	20	41	32	30
Jarvis	—	—	17	39	18	19	32	23	41	29	27
Marchetti	—	—	—	—	—	22	29	28	39	31	28
Yellow Dent	—	—	—	—	—	15	35	18	40	26	27

NOTE: College Hybrid 47 was produced by crossing Cocke's Prolific with Laguna. The results reported are from hybrid seed are produced each season for use the following season. Such hybrid seed cannot be increased year after year as is done with ordinary corn varieties. The Station does not produce such hybrid seed for sale, but when requested will supply instructions for doing so and will cooperate in any way possible.

Reference: Mississippi Agricultural Experiment Station Bulletin 339, "Corn Varieties in Mississippi," page 5, table 1A and B, March 1940, State College, Mississippi.

Mississippi Agricultural Experiment Station Information Sheet 130, "Corn Varieties 1937," State College, Mississippi.

Dates of Planting Corn

Conducted by: North Louisiana Agricultural Experiment Station.

Conducted at: Calhoun, Louisiana.

Period: 1936-1940.

Purpose: To determine the best planting date of corn.

Procedure and Conditions: An experiment was begun in 1936 to get actual grain yields on corn planted at various periods of the planting season. Calhoun Red Cob was planted, receiving applications of 300 pounds per acre of a 5-9-6 fertilizer at planting time and 75 pounds of nitrate of soda when plants were about knee-high.

Table 42.—Time of planting corn—Calhoun, Louisiana, 1936-40.

	Bushels per acre					
Planting date	1936	1937	1938	1939	1940	Average
March 1	23.5	39.5	35.8	27.9	—	31.7
March 15	20.2	29.9	41.6	22.3	32.7	29.3
March 30	17.0	29.5	34.1	31.3	36.6	29.7
April 15	27.3	36.9	33.1	24.8	39.5	32.3
April 30	29.4	37.1	30.1	24.6	34.1	31.1
May 15	17.9	37.7	20.2	19.3	32.4	25.5

Reference: North Louisiana Experiment Station Biennial Report, 1939-1940, page 8, table 4, Calhoun, Louisiana.

Dates of Planting Corn in Louisiana

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1933-1937.

Purpose: To determine how corn yields may be increased economically.

Soil: Sharkey soil of the river bottom.

Procedure and Conditions: The soil is rather fertile and crops usually grown rank when properly cultivated. A complete fertilizer was applied to the seedbed of all the plots in 1933 and in 1937 at the rate of 550 and 300 pounds per acre, respectively. Nitrate of soda was applied as a side-dressing in 1933 and in 1934 at the rate of 200 and 150 pounds per acre, respectively.

Corn seldom suffers from lack of moisture in the vicinity of Baton Rouge. The annual rainfall usually ranges between 55 and 60 inches.

Nine plantings were made each year at approximately 15-day intervals beginning as near February 25 as the weather would permit and ending about July 3. Five-row plots with rows 110 feet long and 4 feet wide were used throughout the experiment. Four replications were planted on each of the nine dates.

The corn was planted with Otootan soybeans in alternate hills in the same row, a duplex hopper being used. The hills were 26 inches apart, with 4 to 7 kernels in each. When the plants reached 8 to 10 inches in height, they were thinned to two stalks per hill. In 1936 and 1937, Creco, a Cocke's Prolific x Yellow Creole hybrid corn, was planted. Yellow Creole was planted the three previous years. The soil preparation, planting and cultivation were the same for each date of planting.

Table 43.—Grain yield different dates of planting corn—Louisiana, 1933-37.

Date of planting	Bushels per acre					
	1933	1934*	1935	1936	1937	Average
February 25	47.8	20.9	60.3	56.2	58.0	48.6
March 12	47.6	19.8	58.8	55.3	57.0	47.7
March 28	53.6	20.7	61.5	59.1	59.7	50.9
April 12	45.9	23.8	54.9	46.1**	58.3	45.8
April 28	43.9	31.8	45.7	56.2	52.5	46.0
May 15	46.7	30.5	42.7	58.2	45.7	44.8
June 1	34.9	31.1	35.4	44.3	26.7	34.5
June 15	29.4	18.8	23.9	20.2	10.9	20.2
July 3	16.6	13.3	9.2	7.3	3.4	10.0

*The low yields in 1934 are attributed to the tropical storm of June 16.

**A high percentage of re-plant plants caused the lower yield of the April 12 planting in 1936.

Reference: Louisiana Agricultural Experiment Station Bulletin 327, "Effect of Date of Planting on Corn Yields, Insect Infestation, and Fungous Diseases," pages 5, 6, and 25, table 12, January 1941, Baton Rouge, Louisiana.

Dates of Planting

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1939-1940.

Purpose: To determine the best planting date for corn.

Soil: Cecil sandy clay loam.

Procedure and Conditions: The test was conducted on plots 1/30-acre in size and replicated six times. The rows were 3½ feet wide and the plants were spaced 18 inches apart in the drill. No fertilizer was applied to corn. Neal's Paymaster corn was used each year. The test was conducted in a 3-year rotation, corn, small grains and summer legumes and cotton and winter legumes. The cotton was fertilized with a balanced fertilizer, small grain top-dressed with 150 pounds nitrate of soda.

Table 44.—Dates of planting corn—Experiment, Georgia, 1939-40.

Planting date	Acre yield air dry cut corn	Acre yield shelled corn
	Lbs.	Bu.
April 1	4,194	27.3
April 15	4,023	24.4
May 1	4,474	25.0
May 15	4,194	22.9

Reference: Georgia Agricultural Experiment Station Circular 126, "Corn Varieties, Hybrids and Cultural Practices," table 11, page 11, March 1941, Experiment, Georgia.

Dates of Planting Corn at Three Stations in Arkansas

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Main Station, Fayetteville, Arkansas.
Cotton Branch Station, Marianna, Arkansas.
Scott Experimental Field, Scott, Arkansas.

Period: Main Station: 1926-1938.
Cotton Branch Station: 1926-1938.
Scott Field: 1927-1931.

Purpose: To determine desirable dates of planting corn.

Soil: Main Station: Clarksville silt loam.
Cotton Branch Station: Lintonia fine sandy and silty loam and Sharkey clay.
Scott Experimental Field: Pulaski fine sandy loam.

Procedure and Conditions: This series of tests conducted in Arkansas using different varieties namely: Paymaster, Funk's 90-day, Hasting's Prolific, Mexican June, and Champion White Pearl which was replaced with Thatcher's Golden Dent. The average for the different years was given for the different planting dates.

The results at the Main Station are 12-year averages for all varieties.

At the Cotton Branch Station the results are as follows: Paymaster, 13-year average; Funk's 90-day, 11-year average; Hasting's Prolific, 10-year average; Mexican June, Champion White Pearl (changed to Thatcher's Golden Dent) 12-year average.

The resulst at Scott Experimental Field are given in 5-year averages for all varieties.

This information may be used as a guide for planting corn in the northern part of Mississippi.

Table 45.—Dates of planting corn in Arkansas, 1926-38.

	Variety					
	Paymaster	Funk's 90-day	Hasting's Prolific	Mexican June	Champion White Pearl***	Average
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
April 1						
Main Station[1]	22.7	23.2	14.8	24.2	21.7	21.3
Cotton Branch Station[2]	19.6	14.7	23.3	23.6	19.9	20.2
Scott Experimental Field*[3]	3.9	3.8	2.7	2.1	2.8	3.2
Average	15.4	13.9	13.6	16.6	14.8	14.9
April 15						
Main Station	18.9	20.9	15.0	24.6	19.5	19.8
Cotton Branch Station	27.2	20.5	23.9	26.6	26.4	25.0
Scott Experimental Field*	16.8	10.4	8.5	12.0	11.3	12.3
Average	20.9	17.2	15.8	21.0	19.0	19.0
May 1						
Main Station	25.6	22.1	20.7	25.2	23.4	23.4
Cotton Branch Station	23.4	22.1	23.1	26.6	22.9	23.6
Scott Experimental Field*	17.7	12.1	9.8	12.6	12.8	13.5
Average	22.2	18.7	17.8	21.4	19.7	20.1
May 15						
Main Station	24.6	22.1	18.7	25.2	22.3	22.6
Cotton Branch Station	26.7	25.9	21.6	25.5	26.6	25.4
Scott Experimental Field	18.6	16.8	13.1	18.6	15.0	17.1
Average	23.3	21.6	17.8	23.1	21.3	21.7
June 1						
Main Station	25.2	23.4	18.4	24.7	18.4	22.1
Cotton Branch Station	26.8	23.2	25.3	27.8	21.5	24.9
Scott Experimental Field**	17.0	15.1	13.6	15.6	12.5	15.8
Average	23.0	20.5	19.1	22.7	17.4	20.9
June 15						
Main Station	15.8	16.0	16.0	25.8	16.5	18.1
Cotton Branch Station	25.7	19.6	16.8	25.1	17.8	20.7
Scott Experimental Field**	19.5	14.5	18.9	18.7	12.5	18.7
Average	20.3	16.7	17.2	23.2	15.6	19.1
July 1						
Main Station	11.5	14.7	14.3	21.5	12.7	14.9
Cotton Branch Station	26.2	15.8	19.3	21.1	17.3	20.0
Scott Experimental Field**	13.0	13.9	11.3	13.2	11.2	12.3
Average	16.9	14.8	14.9	18.6	13.7	15.7
July 15						
Main Station	4.7	7.5	3.9	8.3	6.5	6.2
Cotton Branch Station	15.7	10.1	11.0	14.7	11.7	12.8
Scott Experimental Field**	11.0	9.1	11.8	12.0	9.8	11.2
Average	10.5	8.9	8.9	11.6	9.3	10.0

*Several early plantings not made on account of cold weather or flood.

**Failures of late plantings due to drought.

***At the Main Station and Cotton Branch Station, Champion White Pearl was used from 1927 through 1929 then changed to Thatcher's Golden Dent (1930 through 1938)

[1] The results at the Main Station are 12-year averages for all varieties.

[2] At the Cotton Branch Station the results are as follows: Paymaster, 13-year average; Funk's 90-day, 11-year average; Hasting's Prolific, 10-year average; Mexican June, Champion White Pearl (changed to Thatcher's Golden Dent) 12-year average.

[3] The results at Scott Experimental Field are given in 5-year averages for all varieties.

Reference: Arkansas Agricultural Experiment Station Bulletin 402, "Varietal and Cultural Experiments with Corn," pages 9, 19, 21, and 23, tables 9, 10, and 11, June 1940, Fayetteville, Arkansas.

CORN SPACING

Spacing of corn should be considered very carefully in planning a corn production program. Corn yields are often materially reduced due to the spacing practice used. Experimental information is presented on corn spacing from Mississippi, Louisiana, Georgia and Arkansas.

Corn Spacing at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1913-1914, 1921-1923.

Purpose: To determine spacing that gives highest yields.

Soil: Sandy loam bottom land.

Procedure and Conditions: In the spacing test for 1913-1914 the rows were 4 feet apart and the hills contained one plant. In the 1921-1923 test the rows were 3½ feet apart.

Table 46.—Corn spacing—State College, 1913-14 and 1921-23.

	Bushels per acre, 1913 and 1914	
Distance in drill	March planting	June planting
Four feet	36.7	24.7
Three feet	43.5	28.8
Two feet	45.7	28.5
One foot	47.9	26.9

	Bushels per acre 1921-1923			
Distance in drill	1921	1922	1923	Average
Three feet	24.1	27.0	31.1	27.4
Two feet	23.8	31.6	32.7	29.4
One foot	20.6	25.9	30.7	25.7

Reference: Mississippi Agricultural Experiment Station Information Sheet 44, "Corn Spacing and Tiller Removal," June 1934, State College, Mississippi.

Corn Spacing Test in Louisiana

Conducted by: Northeast Louisiana Experiment Station.

Conducted at: St. Joseph, Louisiana.

Period: 1935-1940.

Purpose: To determine the best spacing for corn growing.

Soil: Very badly worn and to some extent eroded.

Procedure and Conditions: Corn has been fertilized each year, receiving 100 pounds of nitrate of soda per acre, applied when corn was approximately knee-high. No soybeans have been interplanted except in 1939 and 1940.

Table 47.—Corn spacing test—Louisiana, 1935-40.

	Bushels per acre						
Spacing	1935	1936	1937	1938	1939	1940	6-Yr. Average
12 inches	39.6	10.5	53.5	7.4	20.4	42.0	28.9
18 inches	42.5	20.4	50.6	13.0	24.0	50.3	33.5
24 inches	37.5	26.8	43.5	17.8	24.2	48.7	33.1
30 inches	38.8	27.5	36.4	19.1	20.5	47.2	31.6
36 inches	30.6	28.3	31.6	19.9	21.5	46.8	29.8

Reference: Northeast Louisiana Experiment Station Biennial Report, 1939-1940, page 18, table 22, St. Joseph, Louisiana.

Corn Spacing at Calhoun, Louisiana.

Conducted by: North Louisiana Experiment Station.

Conducted at: Calhoun, Louisiana.

Period: 1934-1940.

Purpose: To determine the effect of spacing corn upon the yield.

Soil: Orangeburg fine sandy loam.

Procedure and Conditions: The corn was spaced 12, 18, 24, 30, and 36 inches apart in 4-foot rows with soybeans in alternate hills, and in 6-foot rows with beans planted in the middle.

In 1936, Calhoun Red Cob corn was planted on March 30.

Table 48.—Corn spacing at Calhoun, Louisiana, 1934-40.

Spacing		Bushels ear corn per acre							
		1934	1935	1936	1937	1938	1939	1940	Average
12 inches	a*	13.67	21.10	3.59	——	19.38	——	——	——
	b*	9.00	14.67	1.41	——	15.94	——	——	——
18 inches	a	23.10	21.27	5.57	20.20	32.00	19.00	28.50	24.0
	b	15,60	20.11	5.73	10.30	20.22	22.40	37.30	21.0
24 inches	a	28.10	22.63	8.81	24.70	41.55	20.60	28.70	27.7
	b	21.00	24.35	9.21	16.80	32.44	25.00	38.80	26.4
30 inches	a	25.30	21.00	8.11	23.60	44.11	21.20	28.80	27.2
	b	22.60	25.63	12.59	18.90	34.82	27.40	42.20	28.6
36 inches	a	23.20	18.62	9.50	23.40	45.49	20.00	29.10	26.7
	b	14.18	19.89	9.76	21.70	36.05	27.00	43.10	27.0

*a denotes corn planted in 6-foot rows with beans in middles.

*b denotes corn planted in 4-foot rows with beans in alternate hills in each spacing.

Reference: North Louisiana Experiment Station Biennial Report 1939-1940, page 9, table 5, Calhoun, Louisiana.

Corn Spacing With Soybeans Planted in the Row in Louisiana

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1929-1933, 1931-1936.

Purpose: To determine effect of spacing on yield of corn when planted with soybeans.

Soil: 1929-1933, Alluvial.
1931-1936, Bench.

Procedure and Conditions: The soils used in these tests were of medium fertility. About 400 pounds per acre of complete fertilizer was used on the bench land.

Biloxi or Otootan soybeans were planted in the corn row when the corn was planted. Yellow Creole corn was planted on the alluvial land and Cocke's Prolific on the bench. In all instances, except those noted, 4-foot rows were used and spacings within the row were one stalk per hill at the distances specified in the table.

The rainfall was moderate.

In some years the stands were not satisfactory, making results unreliable. No report is made for such years.

Table 49.—Corn spacing with soybeans planted in the row, Baton Rouge, Louisiana, 1929-36.

Spacing	Bushels corn per acre												
	Alluvial land						Bench land						
	1929	1930	1931	1932	1933	Av.	1931	1932	1933*	1934**	1935**	1936*	Av.
12 inches	53.5	39.0	38.2	43.2	57.2	46.2	22.8	49.5	33.9	12.5	17.4	26.1	27.0
18 inches	—	—	—	—	43.8	—	—	—	36.8	15.9	19.2	28.3	25.1[x]
24 inches	48.8	37.5	31.0	44.2	41.8	40.6	19.6	45.7	38.7	14.9	22.7	28.6	28.4
36 inches	44.9	35.7	28.6	37.3	34.7	36.2	16.3	36.7	35.8	12.4	19.7	24.4	24.2
48 inches	39.2	34.8	26.4	33.6	31.9	33.2	14.8	29.2	—	—	—	—	—

*3½-foot row was used on bench land in 1933 and 1936.

**Planting was made on poor land and weather was dry.

[x] Four-year average.

Reference: Louisiana Agricultural Experiment Station Bulletin 382, "Crops and Soils Information," pages 24 and 25, tables 14 and 15, March 1937, Baton Rouge, Louisiana.

Corn Spacing Test in Georgia

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1937-1940.

Purpose: To determine the best spacing for corn.

Soil: Cecil sandy clay loam.

Procedure and Conditions: In 1937 a series of tests were begun on corn spacing. These tests were conducted on 1/30-acre plots, each test being replicated six times. The corn was planted from May 10 to 15. Hastings Prolific and Neal's Paymaster varieties were used. Austrian winter peas were grown on the land preceding the crop of corn. The 1937 and 1938 corn was side-dressed with 100 pounds nitrate of soda when the corn was knee-high. In 1939 and 1940 no fertilizer was used. This land is run in a 3-year rotation, corn, small grains and summer legumes, cotton and winter legumes. Corn is planted following the winter legumes. This rotation has been carried out on this land for possibly 12 years. The cotton was fertilized with complete fertilizer, the small grains were top-dressed with 150 pounds nitrate of soda. Corn was side-dressed two years

Table 50.—Corn spacing test—Experiment, Georgia, 1937-40.

Width of row	Hill space in row	Air dry cut corn per acre	Shelled corn per acre	Plants per acre
Feet	Inches	Lbs.	Bu.	No.
3.5	42	3,669	21.2	3,555
4.0	36	3,665	22.5	3,555
4.5	32	3,890	23.5	3,555
Average	—	3,741	22.4	——
3.5	21	4,893	25.5	7,110
4.0	18	4,902	25.7	7,110
4.5	16	4,883	25.9	7,110
Average	—	4,993	25.7	——

Reference: Georgia Agricultural Experiment Station Circular 126, "Corn Varieties Hybrids and Cultural Practices," page 12, table 12, March 1941, Experiment, Georgia.

Table 51.—Comparison of narrow rows of corn with medium **and wide** rows, with cowpeas planted between the corn in the medium and wide rows—Arkansas, 1917-24.

	Width of row	Spacing of plants in row	Rate of plants per	Bushels per acre									
				Fayetteville			Scott						
				Paymaster			Mosby						
	feet	inches	acre	1922	1923	1924	1917	1918	1921	1922	1923	1924**	Average
Narrow	4	1 every 36	3630	39.7	21.4	42.1	45.0	—	25.0	25.8	16.4	20.0	29.4
Medium wide	6	1 every 24	3630	27.6	12.6	33.8	39.0	—	21.5	29.2	9.6	13.7	23.4
Narrow	4	1 every 24	5445	50.4	14.8	55.9	—	—	22.7	45.6	4.8	16.5	30.1
Medium wide	6	1 every 16	5445	27.8	12.1	36.5	—	—	18.3	36.3	4.3	11.2	21.0
Narrow	4	1 every 18	7260	43.5	13.4	51.2	—	—	20.3*	26.1	22.1	48.6	34.0
Medium wide	6	1 every 12	7260	27.1	9.0	41.1	—	—	38.8*	24.1	24.6	38.1	27.3
Medium wide	6	1 every 30	2900	23.7	11.6	30.9	—	—	36.7	26.9	23.9*	37.2	27.8
Narrow	4	1 every 24	5445	45.1	15.3	48.2	45.0	26.7	32.7	29.1*	21.6	42.2	34.6
Wide	8	1 every 12	5445	21.6	11.3	25.9	37.8	18.0	19.8	37.1*	11.9	33.4	22.5
Wide	8	1 every 18	3630	21.6	10.3	25.8	—	—	18.3	32.2*	13.2	25.9	19.2
Wide	8	1 every 24	2723	—	—	—	29.4	19.0	—	—	—	—	24.2
Wide	8	1 every 8	8167	—	—	—	36.8	20.9	—	—	—	—	28.9

*Omitted from average on account of unusual soil variation.
**Delta Prolific used instead of Mosby 1924.

References: Arkansas Agricultural Experiment Station Bulletin **200**, **"**Experiments with Varying Stands and Distribution of Corn,**"** pages 29, 31, 32 and 33, table 16, July 1925, Fayetteville, Arkansas.

Fayetteville, Arkansas is on a latitude about 65 miles North of Memphis, Tennessee.

Scott, Arkansas is on about the same latitude as the following Mississippi Counties: Tunica, Tate, Marshall, Benton, Tippah, Prentiss and Tishomingo.

Comparison of Narrow Rows of Corn with Medium and Wide Rows, with Cowpeas Planted Between the Corn on Medium and Wide Rows in Arkansas

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville and Scott, Arkansas.

Period: 1922-1923, 1917-1924.

Purpose: To compare the yields of corn from medium wide rows (6 feet) and wide rows (8 feet) with narrow rows (4 feet) having approximately equal rates per acre of corn plants and legumes drilled between the corn on the medium wide and wide rows.

Procedure and Conditions:

Fertilizers: No fertilizers were applied to these experiments.

The customary practice has been to plant corn in April and the cowpeas later in May. Neal's Paymaster, Mosby and Delta Prolific varieties of corn were used in these experiments.

The results at Scott since 1921 are subject to some error in making comparisons, due to soil variability and in several instances are omitted from final averages. (See table 51).

Rate of Planting Experiment Comparing Varying Spacings of Corn Plants in the Row in Arkansas

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1910-1913.

Purpose: To compare the varying spacings of corn and rates of planting.

Soil: Medium fertile soil.

Procedure and Conditions: All planting has been done by hand. More seed has been planted than was necessary to obtain a full stand. Later, the corn was thinned to meet the specifications of the experiment. Actual counts of stalks, including barren stalks, plants with tillers, tillers with ears, and prolific stalks have been made. In most instances, the stands obtained have conformed very well with the specified rate of planting. Under field conditions, it has seldom been possible to obtain the actual specified number of plants for a given rate of planting. This was found especially true in the thicker rates where 12,000 plants per acre, or over, were specified. In thickest rates of planting, many plants which started were crowded and stunted by plant competition and did not appear in final figures.

Two varieties of corn, Boone County White and Johnson County White, both similar in time of maturity and in growth characteristics, were used.

The rows were 3-2/3 feet wide.

Table 52.—Rates of planting experiment comparing varying spacings of corn plants in the row—Arkansas, 1910-13.

Spacing of plants in the rows	Rate of plants per acre	Yield corn in bushels per acre				Average
		1910	1911	1912	1913	
1 plant every 44 inches	3240	27.3	32.7	24.0	19.9	26.0
1 plant every 40 inches	3605	26.6	19.9	28.5	17.8	23.2
1 plant every 36 inches	4116	39.5	25.9	29.2	14.9	27.4
1 plant every 30 inches	4940	35.3	30.8	28.1	21.9	29.0
1 plant every 24 inches	5940	45.6	40.6	33.6	22.1	35.5
1 plant every 18 inches	7920	48.9	44.0	34.9	27.4	38.8
1 plant every 14-2/3 inches	9720	44.9	42.9	27.9	36.5	38.1
1 plant every 11 inches	12960	44.6	28.4	36.2	29.5	34.7

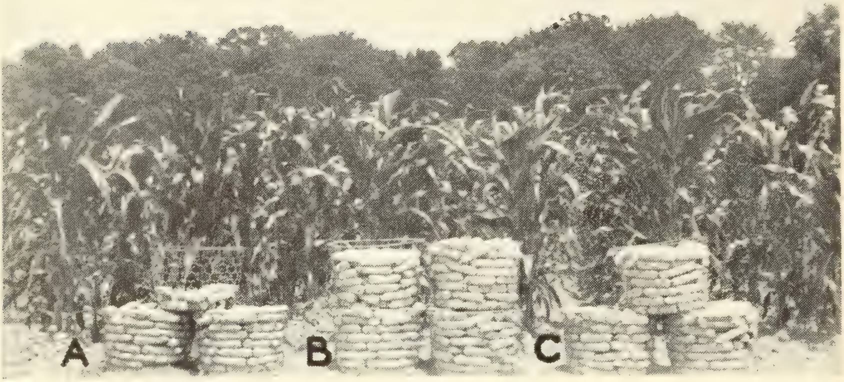

Figure 9.—Fertilizer treatment on corn at the Delta Branch Station, 6-year average, 1935-40. Each basket represents 10 bushels yield. A. No fertilizer, 22 bushels per acre; B, 200 pounds sodium nitrate, 38 bushels per acre; C, 100 pounds sodium nitrate, 29 bushels per acre.

Reference: Arkansas Agricultural Experiment Station Bulletin 200, "Experiments with Varying Stands and Distribution of Corn," pages 4, 5, and 6, table 3, July 1925, Fayetteville, Arkansas.

Checked Versus Drilled Planting of Corn

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Scott, Arkansas.

Period: 1917, 1921 and 1922.

Purpose: To compare checked versus drilled methods of planting corn.

Procedure and Conditions: In 1917, Southern Beauty, Robert's Red Cob, and Mosby varieties were used. Results given are an average of the three. Mosby was used in 1921 and 1922.

The rows were 4 feet wide.

Table 53.—Checked versus drilled planting of corn—Arkansas, 1935-40.

Rate and spacing of plants per row, in.*	Rate of plants per acre	Mosby			
		1917**	1921	1922	Average
Checked 2 every 48	5445	40.4	36.8	25.7	36.8
Drilled 1 every 24	5445	43.8	37.4	27.3	39.2
Checked 3 every 48	8167	42.4	36.4	27.1	38.1
Drilled 1 every 16	8167	41.1	34.2	27.3	37.1
Checked 4 every 48	10890	37.1	38.8	30.4	35.4
Drilled 1 every 12	10890	36.9	36.8	25.8	34.1

*Rows four feet wide.

**Yield represent averages of three varieties

Reference: Arkansas Agricultural Experiment Station Bulletin 200, "Experiments with Varying Stands and Distribution of Corn," page 27, table 14, July 1925, Fayetteville, Arkansas.

A Comparison of Rates of Planting Different Varieties of Corn

Conducted by: Arkansas Agricultural Experiment Station.
Conducted at: Fayetteville and Scott, Arkansas.
Period: 1921-1924, 1922-1924.
Purpose: To compare the rate of planting different varieties of corn.
Soil: At Fayetteville, medium fertile land.
At Scott, alluvial.

Table 54.—A comparison of rates of planting different varieties of corn—Arkansas, 1921-24.

Distance of plants apart in rows Inches*	Rate of plants per acre	Yield in bushels corn per acre							
		Fayetteville			Scott				
		Medium fertile land			Alluvial land				
		1922	1923	1924	1921	1922	1923	1924	Average
Neal's Paymaster									
48	2722	46.5	24.6	42.7	38.8	40.8	19.8	42.1	36.5
42	3111	49.5	27.0	44.9	43.2	47.9	31.9	34.2	38.4
36	3630	53.5	25.3	48.4	46.4	48.8	20.1	41.0	40.5
30	4356	57.4	26.1	57.7	48.0	42.9	20.3	39.7	41.7
24	5445	61.6	26.2	66.8	51.2	41.6	17.3	25.5	41.5
18	7260	62.0	36.6	69.7	52.8	34.5	16.9	19.1	41.7
12	10890	65.6	24.3	64.3	46.4	23.8	16.4	10.7	35.9
8	16336	50.2	14.4	49.1	34.8	18.4	13.9	7.5	26.9
Thibault Mexican June									
48	2722	45.2	19.1	—	—	31.5	25.1	—	30.2
42	3111	52.5	23.7	—	—	32.3	30.9	—	34.8
36	3630	54.7	20.4	—	—	33.2	32.6	—	35.2
30	4356	55.1	13.7	—	—	31.3	28.8	—	34.7
24	5445	53.6	7.5	—	—	39.2	44.8	—	36.3
18	7260	47.6	5.6	—	—	42.5	41.9	—	34.4
12	10890	51.7	2.1	—	—	48.4	32.5	—	33.7
8	16336	49.6	1.0	—	—	44.0	23.2	—	29.5
Hasting's Prolific									
48	2722	35.1	12.7	36.8	38.8	41.2	25.5	27.4	31.1
42	3111	34.1	15.9	50.6	38.4	45.3	22.1	28.3	33.5
36	3630	32.5	15.3	36.6	38.6	48.2	18.3	23.5	31.9
30	4356	29.7	5.9	44.2	42.4	41.2	15.2	25.1	30.5
24	5445	24.7	5.3	50.6	44.4	51.7	12.4	19.1	29.7
18	7260	17.1	5.0	53.0	46.6	51.0	8.7	20.4	28.8
12	10890	9.9	3.2	52.5	50.8	52.4	4.0	13.9	26.7
8	16336	4.4	2.5	41.2	55.2	52.5	2.2	11.2	24.2

*Rows four feet apart.

Reference: Arkansas Agricultural Experiment Station Bulletin 200, "Varying Stands and Distribution of Corn," page 16, table 8, July 1925, Fayetteville, Arkansas.

FERTILIZING CORN

Successful corn production in Mississippi depends largely on the addition of plant food elements. Since many of the soils on which corn is produced in Mississippi are very low in plant food, the plant foods available in the soils must be supplemented if the average yield of corn is to be increased. This

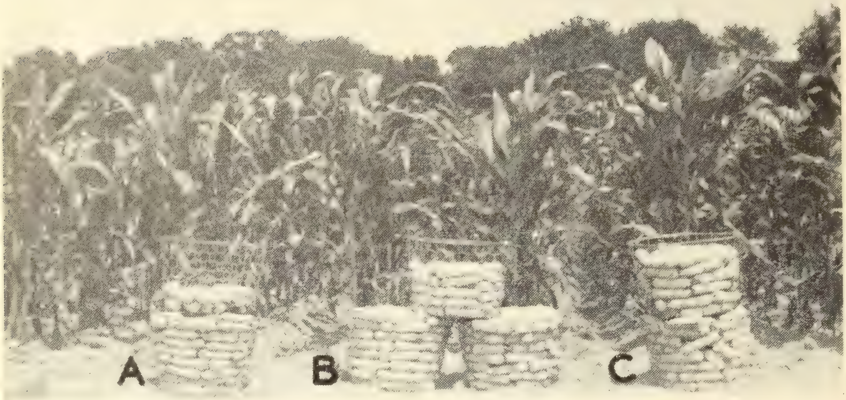

Figure 10.—Fertilizer treatment on corn at the Natchez Branch Station, 4-year average, 1934-37. Each basket represents 10 bushels yield. A, No fertilizer, 12 bushels per acre; B, 200 pounds sodium nitrate, 25 bushels per acre; C, 100 pounds sodium nitrate, 18 bushels per acre.

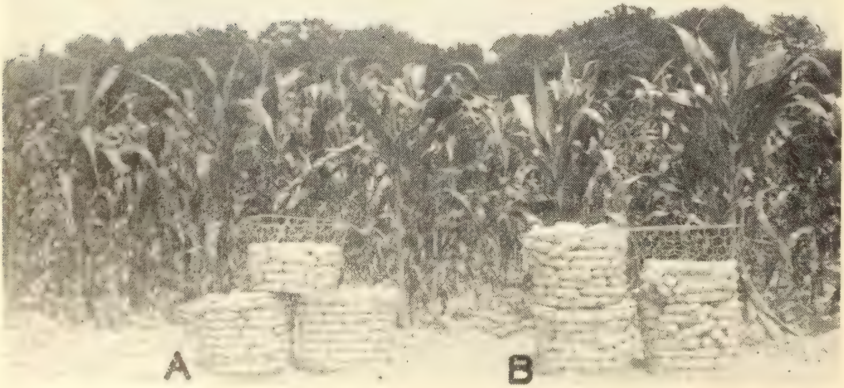

Figure 11.—Fertilizer treatment on corn at the Main Station, State College, 8-year average, 1930-37. Each basket represents 10 bushels yield. A, No fertilizer, 25 bushels per acre; B, 30 pounds nitrogen, 33 bushels per acre.

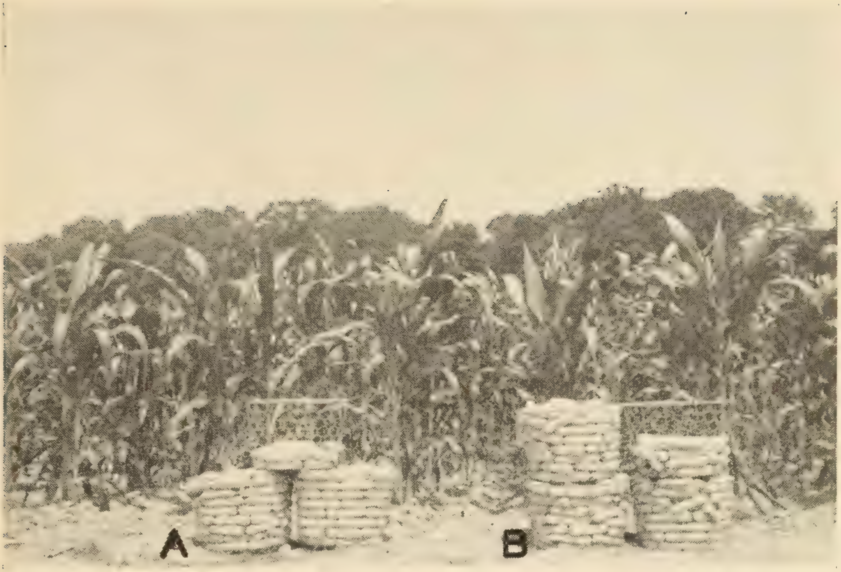

Figure 12.—Fertilizer treatment on corn at the Holly Springs Branch Station, 6-year average, 1935-40. Each basket represents 10 bushels yield. A, No fertilizer, 22 bushels per acre; B, 150 pounds sodium nitrate, 33 bushels per acre.

has been done by the addition of commercial fertilizer and manure, and in many cases the nitrogen supply has been supplemented by the use of summer and winter legumes.

Fertilizing corn involves a decision on several factors. Some of these factors are the source of fertilizer, the time of applying, the analysis, and the amount to use. There have been a number of tests conducted on these factors. Experimental information is presented in this section on sources of nitrogen, rates of application, time of applying nitrogen, fertilizer analysis, barnyard manure, winter legumes, and summer legumes. The fertilizer practices used by corn producers in different areas of Mississippi are shown in Part I of this publication.

Fertilizer Analysis Test on Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Holly Springs Branch Experiment Station, Holy Springs, Mississippi.

Period: 1925-1928.

Purpose: To compare the effect of different fertilizer treatments on corn yields.

Soil: Sandy loam valley land.

Procedure and Conditions: Corn in these tests was planted from April 15 to the latter part of May. Neal's Paymaster corn was used. Plots were 1/20-acre in size being replicated two or three times in each test.

Table 55.—Fertilizer test with corn, Holly Springs, 1925-28.

	Bushels per acre				
	1925	1926	1928	Average	Increase
No fertilizer	18.84	33.51	36.15	29.50	——
100 nitrate of soda	23.78	37.10	41.40	34.09	4.59
100 nitrate of soda 200 superphosphate	24.22	40.90	40.50	35.20	5.70
100 nitrate of soda at planting 100 nitrate of soda at 1st working	28.68	39.00	53.00	40.23	10.73
100 nitrate of soda at planting 200 superphosphate at planting 100 nitrate of soda at 1st working	28.65	38.00	41.70	36.11	6.61
200 superphosphate 200 nitrate of soda	31.38	52.20	40.70	31.42	11.92
200 nitrate of soda 400 superphosphate	30.30	52.20	43.60	42.36	12.86
150 ammonium sulphate 400 superphosphate	25.14	43.50	42.30	36.98	7.48
150 ammonium sulphate	27.29	40.30	47.20	38.26	8.76
150 ammonium sulphate 400 superphosphate 200 kainit	28.32	45.00	46.20	39.84	10.34

Reference: Annual Reports of Holly Springs Branch Experiment Station for the years 1925, 1926 and 1928, State College, Mississippi.

Fertilizer Analysis Test With Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Lonnie Andrew's farm near Union, Neshoba County, Mississippi.

Period: 4 years.

Purpose: To determine yield of corn with varying fertilizer analysis.

Soil: The soil is above the average in fertility.

Table 56.—Corn fertilizer analysis test, Neshoba County.

Treatment	Bushels per acre 4 year average
600 pounds 6-0-6	32.3
600 pounds 0-8-0	30.3
600 pounds 0-0-8	28.9
600 pounds 6-8-0	37.3
600 pounds 6-0-8	30.9
600 pounds 0-8-8	30.0
600 pounds 6-8-6	35.1
600 pounds 6-0-0 as side-dressing	33.1
No fertilizer	24.6

Reference: Mississippi Agricultural Experiment Station Information Sheet 67, "Corn Fertilization," January 1935, State College, Mississippi.

Analysis Test With Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: H. Templeton's Farm, Starkville, Mississippi.
Yeates' Farm, near Starkville, Mississippi.

Period: H. Templeton's Farm, 1931.
Yeates' Farm, 1932.

Purpose: To determine yields of corn with varying fertilizer analysis.
Soil: Lufkin clay loam (flatwoods).

Table 57.—Analysis test with corn—2 farms in Oktibbeha County.

Treatment	Bushels per acre	
	H. Templeton farm	Yeates farm
600 pounds 6-0-0	30.9	25.7
600 pounds 6-0-4	31.6	23.9
600 pounds 6-4-4	31.4	24.5
600 pounds 6-8-4	31.3	21.3
600 pounds 6-8-0	28.7	26.2
600 pounds 6-8-8	31.3	23.8
No fertilizer (actual yield)	21.5	8.9

Reference: Mississippi Agricultural Experiment Station Information Sheet 67, "Corn Fertilization," January 1935, State College, Mississippi.

Fertilizer Analysis Test With Corn at Poplarville

Conducted by: South Mississippi Branch Experiment Station.
Conducted at: Poplarville, Mississippi.
Period: 1925-1929.
Purpose: To determine the yield of corn with varying fertilizer analyses.

Table 58.—Fertilizer analysis test on corn at Poplarville, Mississippi, 1925-29.

Plot	Fertilizer per acre		Bushels per acre					
	600 lbs. of	Equivalent to N-P-K lbs.	1925	1926	1927	1928	1929	Average
1	None	0-0-0	—	—	—	33.2	23.0	—
2	4-8-4	24-48-48	51.0	12.9	38.5	39.7	38.0	36.3
3	4-8-6	24-48-36	56.1	13.0	40.5	41.4	37.0	37.7
4	4-8-4	24-48-24	56.0	13.1	40.1	39.8	38.0	37.7
5	None	0-0-0	—	—	—	30.0	21.5	—
6	4-8-2	24-48-12	57.5	15.2	45.0	38.9	37.0	11.8
7	4-8-0	24-48-0	58.5	14.8	42.2	41.4	37.5	11.9
8	6-8-4	36-48-24	71.2	17.4	53.1	52.2	45.0	48.1
9	None							
10	8-8-4	48-48-24	65.4	18.2	47.2	46.4	41.0	44.0
11	4-6-4	24-36-24	58.6	16.7	42.5	39.1	36.0	38.9
12	4-4-4	24-24-24	54.3	15.3	40.4	37.3	37.0	37.2
13	None	0-0-0	41.9	9.5	28.5	29.1	27.5	27.3
	4-8-4 at the rate of							
14	1200 lbs.	48-96-48	62.6	16.7	51.8	51.0	40.5	44.9
15	1800 lbs.	72-144-72	61.6	14.7	55.7	52.7	41.5	45.5
16	2400 lbs.	96-192-96	56.1	13.9	57.0	55.1	37.0	44.2

Reference: Annual Reports, Poplarville Branch Experiment Station, Poplarville, Mississippi.

Fertilizer Analysis Test With Corn

Conducted by: Raymond Branch Experiment Station.
Conducted at: Raymond, Mississippi.
Period: 1928-1933.
Purpose: To determine yield of corn with varying fertilizer analysis.
Soil: Vicksburg silt loam (bottom land soil).

Procedure and Conditions:

Planting dates of corn: 1928, May 10; 1929, May 5; 1930, May 13; 1931, May 12.

Table 59.—Fertilizer analysis test with corn—Raymond, Mississippi, 1928-33.

Pounds fertilizer per acre				Bushels per acre					
Nitrate of soda	Super-phosphate	Muriate of potash	N-P-K	1928	1929	1930	1931	1933	Average
200	100	—	30-16-0	22.2	27.0	25.9	30.8	28.2	27.2
200	100	50	30-16-25	22.9	38.0	24.8	20.0	27.2	26.0
200	--	50	30-0-25	26.5	33.5	26.5	33.0	28.5	26.9
200	—	—	30-0-0	25.0	34.7	27.9	31.2	28.8	28.5
0	0	0	0-0-0	11.7	23.2	19.1	34.1	21.2	20.3
200	200	—	30-32-0	22.4	40.9	35.2	34.5	32.3	30.9
200	200	50	30-32-35	23.7	39.4	31.5	36.4	34.8	33.0
200	—	—	30-0-0	26.0	36.4	29.5	32.1	30.0	30.8

Reference: Unpublished data, Raymond Branch Experiment Station, Raymond, Mississippi.

Corn Fertilizer Tests in Mississippi

Conducted by: Mississippi Agricultural Experiment Station in cooperation with Smith-Hughes instructors.

Conducted at: Lake, Enterprise, and Duck Hill, Mississippi.

Period: 1934-1935.

Purpose: To determine the effect of varying plant food elements on yield of corn.

Procedure and Conditions: In the spring of 1934 cooperative fertilizer and soil fertility work was started by a number of Smith-Hughes instructors and the Agronomy Department of Mississippi State College. The plan was as follows: The Agronomy Department assisted the instructors select and measure the fields, mixed and weighed the fertilizer for each plot, and delivered it to the instructors. All other operations such as fertilization, planting, suprvision and harvesting were in charge of the instructors. These operations were carried out by methods used in experimental work. The plots were located on private farms within the instructor's district.

The fertilization per acre was as follows:

Nitrogen equal to 100 pounds ammonium sulphate.
Phosphorus equal to 100 pounds 20 percent superphosphate.
Potash equal to 20 pounds 50 percent muriate of potash.
Lime equal to 200 pounds limestone.

Table 60.—Corn fertilizer test, three locations—Mississippi, 1934-35.

	Bushels per acre					
				1935 cooperators and results		
	1934	1935	1934-35	G. A. Noel Lake, Miss.	J. L. May Enter-prise, Miss.	B. M. Trapp Duck Hill, Miss.
Nitrogen	33.2	26.4	29.0	35.3	16.3	27.6
Nitrogen-Phosphorus	31.7	26.0	27.9	31.2	16.8	30.2
Nitrogen-Phosphorus-Potash	33.5	26.9	29.3	34.1	18.4	28.3
Nitrogen-Phosphorus-Potash-Lime	32.7	27.5	29.1	34.2	16.6	29.7
No fertilizer (actual yield)	26.9	19.3	22.1	24.6	11.4	22.0

Reference: Mississippi Agricultural Experiment Station Information Sheets 70 and 100, State College, Mississippi.

Fertilizer Analysis Experiment With Corn

Conducted by: Pee Dee Agricultural Experiment Station.

Conducted at: Florence, South Carolina.

Period: 1921-1928.

Purpose: To determine yields of corn with varying fertilizer analysis.

Soil: Orangeburg very fine sandy loam, which at the beginning of the test was in a very high state of fertility.

Procedure and Conditions: There are four series of plots in the experiment, each consisting of 43 one-tenth acre plots. Series A, B, and C are in a regular 3-year soil building rotation, consisting of cotton the first year; corn interplanted with cowpeas for soil improvement the second year; and oats followed by peas for hay the third year. The plots are each 24 feet wide, which permits four 6-foot rows. The corn yields reported have been calculated from the two inside corn rows.

Fertilizer: Except as otherwise stated the source of phosphorus has been superphosphate; the source of potash has been muriate of potash; and on the fertilized plots, from 1 to 26 the nitrogen has been derived one-half from

Table 61.—The yield of corn as influenced by the percentage of nitrogen, phosphorus and potash in a complete fertilizer, 1000 pounds per acre—South Carolina, 1921-28.

Treatment	(Bushels per acre in a cotton-corn-oats-hay rotation)								
	1921	1922	1923	1924	1925	1926	1927	1928	Average
Nitrogen variation									
Av. checks (none)	43.5	42.8	41.6	40.9	31.8	39.4	45.9	23.9	38.7
0-8-4	50.0	40.3	46.7	50.0	33.3	38.9	44.5	29.2	41.6
1 2/3-8-4	47.2	51.9	48.6	48.6	38.9	47.7	45.8	37.5	45.8
2 1/3-8-4	62.5	51.4	55.8	54.2	42.4	48.3	64.5	36.1	51.9
3 1/3-8-4	61.1	60.3	49.4	51.4	46.4	57.5	66.6	33.3	53.3
4 1/6-8-4	59.7	65.3	57.5	52.5	43.3	58.7	58.3	34.7	53.7
5-8-4	63.9	68.0	51.1	51.9	50.0	54.7	66.6	36.7	55.4
6 2/3-8-4	62.5	68.0	51.4	54.2	48.6	50.8	72.9	37.2	55.8
8 1/3-8-4	53.9	66.6	49.4	50.6	54.7	56.9	62.5	34.7	54.9
Phosphorus variation									
3 1/3-0-4	61.1	51.4	46.1	51.9	38.9	30.0	54.1	28.6	45.3
3 1/3-2-4	52.8	53.6	48.8	50.0	41.7	37.5	63.3	30.6	47.3
3 1/3-4-4 (1)	56.9	53.1	48.8	54.2	43.6	46.1	64.5	37.2	50.6
3 1/3-6-4	63.9	56.1	49.7	51.9	39.4	43.1	56.2	34.7	49.4
3 1/3-8-4	61.1	60.3	49.4	51.4	46.4	57.5	66.6	33.3	53.3
3 1/3-10-4	58.3	61.1	52.5	48.6	41.7	55.5	58.3	31.9	51.0
3 1/3-12-4	54.2	61.1	55.8	50.0	46.1	57.2	64.5	37.8	53.3
3 1/3-16-4	58.3	63.8	52.1	52.8	42.4	53.9	60.4	36.4	52.6
Potash variation									
3 1/3-8-0	55.6	56.9	53.3	58.3	44.4	50.0	63.3	20.6	51.6
3 1/3-8-1	55.6	55.5	56.7	49.2	44.7	34.7	65.0	33.3	49.3
3 1/3-8-2	63.9	55.5	52.2	55.5	47.2	33.3	66.2	35.8	51.2
3 1/3-8-3	63.9	65.3	50.0	49.2	44.4	52.7	60.4	36.1	52.8
3 1/3-8-4	61.1	60.3	49.4	51.4	46.4	57.5	66.5	33.3	53.3
3 1/3-8-5	55.6	68.6	53.3	50.0	46.9	55.0	66.6	35.0	53.9
3 1/3-8-6	55.6	59.7	51.1	54.3	47.2	56.9	62.5	38.9	53.3
3 1/3-8-8 (1)	52.8	60.0	45.5	51.1	43.1	47.3	58.3	34.7	49.1
Av. checks (none)	43.5	42.8	41.6	40.9	31.8	39.4	45.9	23.9	38.7

(1) All nitrogen from dried blood.

nitrate of soda and one-half from dried blood. The nitrogen on plots 27 to 33 has been derived from dried blood and cottonseed meal. Plots 34 through 43 have had all nitrogen solely from blood except the side dressing of nitrate of soda on plots 40, 42, and 32.

Unless otherwise stated, all fertilizers have been applied to corn when plants were knee-high.

Reference: South Carolina Agricultural Experiment Station Bulletin 262, "Fertilizer Rotation Experiments at the Pee Dee Station," pages 6, 9, 13, 18, and 23, tables 7, 12, and 18, November 1929, Clemson, South Carolina.

Florence, South Carolina is on about the same latitude as Rosedale, Ruleville, Calhoun City, Houston, Okolona and Amory, Mississippi.

Fertilizer Analysis Test With Corn

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Farm of B. B. Bouknight in Edgefield county near Trenton, South Carolina.

Period: 1921-1925.

Purpose: To determine yield of corn with varying fertilizer analysis.

Soil: Greenville clay loam.

Procedure and Conditions: When the experiment was begun in 1921, the field was in a high state of cultivation. Cotton had been the principal crop grown and to this crop very liberal annual applications of a complete fertilizer had been applied for several years. This should be kept in mind in studying the results, for it is possible that a sufficient quantity of the mineral elements—phosphorus and potassium—had accumulated to largely make the effect of these two elements when applied directly to the corn. The analysis used in this test was 3⅓-8-3, except where noted, and at the rate of 600 pounds per acre.

Where ammonia and potash were applied in constant amounts with varying percentages of superphosphate, the differences in yield were not consistent and were no more than may be accounted for through soil variation. It will be noted that the plot receiving no phosphorus gave a higher average yield than did either of the plots to which phosphorus was applied. (See table 62).

Corn Fertilizer Experiments

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: The farm of Ex-Governor R. I. Manning in Lee County, South Carolina.

Period: 1921-1923.

Purpose: To determine yields of corn with varying fertilizer analysis.

Soil: Ruston sandy loam, being a medium heavy sandy loam typical of that scetion.

Procedure and Conditions: When the experiment was started, the field was in a fair state of cultivation. Cotton had been the principal crop grown for a number of years; to a certain extent some form of rotation had been practiced, but not intensely fertilized (table 63).

Table 62.—Fertilizer analysis experiment with corn, South Carolina, 1921-25. 600 pounds fertilizer per acre.

	Bushels per acre					
	1921	1922	1923	1924	1925	Average
	Nitrogen and potash constant					
3 1/3-0-3	39.7	61.7	32.7	38.9	20.1	38.4
3 1/3-2-3	39.5	56.4	34.4	39.9	20.9	36.4
3 1/3-4-3	43.1	56.0	35.0	34.8	21.3	38.0
3 1/3-6-2	37.3	52.9	32.4	30.8	18.8	34.4
3 1/3-8-3	38.6	55.0	33.6	32.8	20.2	36.0
3 1/3-10-3	38.7	54.4	27.2	34.4	19.2	34.8
	Phosphorus and potash constant					
0-8-3	35.5	48.4	25.1	34.0	16.3	31.9
1 2/3-8-3	39.7	50.7	31.0	39.7	16.0	35.4
2 1/2-8-3	35.1	45.6	20.9	33.8	18.6	32.8
3 1/3-8-3	38.6	55.0	33.6	32.8	20.2	36.0
4 1/6-8-3	35.7	43.6	23.7	31.9	21.1	32.2
5-8-3	36.1	53.7	36.7	29.9	19.0	35.1
6 2/3-8-3	35.3	49.9	36.9	35.8	22.9	36.2
6 2/3-8-3	37.4	55.0	43.2	37.6	21.8	39.0
	Nitrogen and phosphorus constant					
3 1/3-8-0	38.0	54.7	32.1	30.5	25.3	36.1
3 1/3-8-1	39.2	52.3	37.4	36.7	24.7	39.1
3 1/3-8-2	37.1	57.3	35.1	34.6	23.0	37.4
3 1/3-8-3	38.6	55.0	33.6	32.8	20.2	36.0
3 1/3-8-4	39.0	50.8	32.3	32.3	13.1	33.5
	Rate of complete fertilizer 3 1/3-8-3					
No fertilizer	30.5	42.2	18.6	33.7	20.9	29.2
150 lbs.	29.7	42.7	23.6	33.0	19.7	29.7
300 lbs.	33.7	50.0	31.5	34.9	17.7	33.6
450 lbs.	35.5	51.5	23.2	34.9	14.7	32.0
600 lbs.	38.6	49.8	33.6	32.8	20.0	35.0
750 lbs.	39.7	53.4	31.3	29.1	20.8	34.9
900 lbs.	39.2	51.0	28.3	27.2	16.7	32.5
1050 lbs.	38.6	49.2	33.3	27.9	16.3	33.1
1200 lbs.	40.7	46.8	35.2	29.6	19.4	34.3

Reference: South Carolina Agricultural Experiment Station Bulletin 248, "Corn Variety and Fertilizer Experiments," pages 23 and 24, table 25, March 1928, Clemson, South Carolina.

Corn Fertilizer Experiment

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: State Hospital in Richland county in the heart of the Sand Hills.

Period: 1920-1925.

Purpose: To determine yields of corn with varying fertilizer analysis.

Soil: Norfolk sandy loam.

Procedure and Conditions: When the field for the experiment was selected, the soil was in a very poor state of cultivation, having been abandoned for this reason. It is excessively drained and therefore very susceptible to droughts.

The analysis used in this test was 3 1/3-8-4 except where noted and at the rate of 1000 pounds per acre, except 1924 and 1925, when the rate was reduced to 600 pounds per acre.

Because of the lack of natural fertility in the soil it is to be expected that crops would respond to all fertilizer ingredients applied. (See table 64).

Table 63.—Fertilizer experiment with corn, South Carolina, 1921-23
400 pounds fertilizer per acre.

	Bushels per acre			
	1921	1922	1923	Average
Nitrogen and potash constant				
3 1/3-0-3	31.1	28.4	15.5	25.0
3 1/3-2-3	33.5	29.0	19.5	27.3
3 1/3-4-3	32.2	28.3	19.3	26.6
3 1/3-6-3	32.1	34.0	21.7	29.3
3 1/3-8-3	32.1	30.4	20.5	27.7
3 1/3-10-3	33.3	29.5	22.7	28.5
Phosphorus and potash constant				
0-8-3	27.2	23.5	14.2	21.6
1 2/3-8-3	28.5	30.6	18.1	25.7
2 1/2-8-3	31.1	31.9	21.3	28.1
3 1/3-8-3	32.1	30.4	20.5	27.7
4 1/6-8-5	28.7	29.2	22.3	26.7
5-8-3	30.9	27.7	22.5	27.0
6 2/3-8-3	37.3	36.3	22.9	32.3
8 1/3-8-3	37.4	35.8	21.2	31.5
Nitrogen and phosphorus constant				
3 1/3-8-0	33.7	39.3	29.1	34.0
3 1/3-8-1	33.6	32.4	26.6	30.9
3 1/3-8-2	33.7	37.6	24.8	32.0
3 1/3-8-3	32.1	30.4	20.4	27.7
3 1/3-8-4	31.5	30.1	19.4	27.0
Rate of complete fertilizer 3 1/3-8-3				
No fertilizer	29.3	24.8	19.6	24.6
133 lbs.	33.3	24.1	22.0	26.5
266 lbs.	33.4	33.7	17.4	28.2
400 lbs.	32.1	30.4	20.5	27.7
533 lbs.	29.8	36.0	18.3	28.0
666 lbs.	33.5	33.8	20.6	29.3
800 lbs.	35.6	37.1	21.4	31.4
933 lbs.	36.6	41.8	24.4	34.3
1066 lbs.	38.0	30.2	23.9	30.7

Reference: South Carolina Agricultural Experiment Station Bulletin 248, "Corn Variety and Fertilizer Experiment," page 25, table 27, March 1928, Clemson, South Carolina.

Grades of Fertilizer For Corn

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Alexandria, Aliceville, Brewton, Monroeville and Prattville Experimental Fields, Sand Mountain, Tennessee Valley, and Wiregrass Substations.

Period: 1930-1935.

Purpose: To present experimental information to determine the best grade of fertilizer to use in corn production.

Soils: This test was conducted at a number of places distributed over the state of Alabama having tests located in north, central and southern parts of the State, which takes in a representative number of soils of the state. These soils are similar to the hill soils of Mississippi.

Procedure and Condition: In this test various grades of fertilizers were used at the rate of 600 pounds per acre. In most cases corn was planted after cotton which might have some bearing on the results secured in this series of tests. (See table 65).

Table 64.—Fertilizer experiment with corn at State Park, South Carolina, 1920-25. 1000 pounds fertilizer per acre.

	Bushels per acre						
	1920	1921	1922	1923	1924*	1925	Average
Nitrogen and potash constant							
3 1/3-0-4	22.3	24.2	17.8	18.5	24.4	17.8	20.8
3 1/3-2-4	25.8	23.7	19.4	28.0	27.0	17.5	23.6
3 1/3-4-4	21.4	21.3	24.4	24.5	22.4	18.6	22.1
3 1/3-6-4	22.1	20.9	26.7	31.1	22.9	18.8	23.7
3 1/3-8-4	25.0	25.3	25.4	25.6	27.2	20.1	24.8
3 1/3-10-4	25.1	24.4	29.1	22.1	27.7	20.6	24.8
Phosphorus and potash constant							
0-8-4	8.8	11.9	14.3	17.7	21.5	13.1	14.6
1 2/3-8-4	15.6	19.5	20.4	20.1	23.0	16.2	19.1
3 1/3-8-4	25.0	25.3	25.4	25.6	27.2	20.1	24.8
5-8-4	24.8	30.1	28.8	25.6	28.6	21.9	26.6
6 2/3-8-4	36.8	35.1	29.5	26.0	30.7	21.3	29.9
Nitrogen and phosphorus constant							
3 1/3-8-0	25.6	18.8	21.8	18.4	25.3	18.2	21.3
3 1/3-8-2	30.2	21.9	24.8	20.3	18.9	22.0	23.0
3 1/3-8-4	25.0	25.3	25.4	25.6	27.2	20.1	24.0
3 1/3-8-6	27.3	28.3	24.0	22.0	29.1	18.8	24.9
Rate of complete fertilizer 3 1/3-8-4							
No fertilizer	6.3	4.9	11.2	15.9	9.0	9.8	9.5
400 lbs.	18.2	15.7	16.0	20.9	13.3	12.6	16.1
800 lbs.	25.9	20.0	24.3	25.5	22.3	19.1	23.0
1000 lbs.	25.0	25.3	25.4	25.6	27.2	20.1	24.8
1200 lbs.	31.8	28.5	28.2	26.7	32.8	20.9	28.1
1600 lbs.	38.1	34.1	32.6	31.4	34.3	21.0	31.9
2000 lbs.	44.1	35.5	33.7	32.1	39.9	20.4	34.3
2400 lbs.	43.4	22.6	22.8	40.8	31.7	22.9	30.7

*In 1924 the base rate of application was changed from 1000 pounds per acre to 600 pounds per acre.

Reference: South Carolina Agricultural Experiment Station Bulletin 248, "Corn Variety and Fertilizer Experiments," pages 26 and 27, table 28, March 1928, Clemson, South Carolina.

Nitrogen Sources Test With Corn

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1935-1941.

Purpose: To compare the various sources of nitrogen for corn. (See table 66).

Table 65.—Six-year average yield of corn, bushels per acre, produced at five experimental fields and three substations in Alabama when various grades of fertilizer were used at the rate of 600 pounds per acre—Alabama, 1930-35.

Plot	Fertilizer N-P_2O_5-K_2O	Experimental fields					Substations			
		Alexandria	Aliceville	Brewton	Monroeville	Prattville	Sand Mountain[1]	Tennessee Valley[1]	Wiregrass	Average
1	6-10-4 (check)	30.2	26.2	39.9	31.9	34.7	35.9	38.5	32.5	33.7
2	0-10-4	16.3	5.7	18.0	13.3	9.9	9.1	27.9	20.8	15.1
3	2-10-4	22.9	14.4	24.9	21.7	18.8	16.6	31.3	27.2	22.2
4	4-10-4	27.1	22.1	31.8	28.1	27.5	26.9	35.4	32.5	28.9
5	6-10-4 (check)	28.5	28.8	36.0	32.7	34.7	37.1	37.2	36.3	33.9
6	6-10-2	29.7	29.1	35.0	32.8	35.4	36.2	37.0	37.4	34.1
7	6-0-0	30.1	29.0	33.0	32.2	34.6	35.1	35.2	36.7	33.2
8	6-10-6	30.6	29.6	36.8	32.7	35.2	34.8	37.3	35.6	34.1
9	6-10-4 (check)	29.9	29.6	39.8	32.7	34.5	35.0	37.8	34.5	34.1
10	6-8-4	30.1	28.9	38.5	32.6	35.2	35.1	37.7	35.6	34.2
11	6-6-4	29.4	28.9	37.9	32.3	34.8	35.4	38.3	34.7	34.0
12	4-8-4	25.7	23.1	33.4	27.3	28.2	25.4	36.5	30.9	28.8
13	6-10-4 (check)	29.2	28.1	37.2	32.3	35.3	35.6	36.9	33.8	33.6
14	3-8-5	24.2	17.5	29.5	24.3	24.5	20.2	33.8	28.0	25.3
15	3-10-3	24.5	18.5	28.9	24.4	23.7	20.0	34.5	28.6	25.4
16	2-11-3	21.9	15.7	26.4	19.5	18.7	15.3	33.1	25.1	22.0
17	6-10-4 (check)	30.1	27.7	40.4	31.8	36.1	35.3	37.6	31.4	33.8
Average of checks		29.6	28.1	38.5	32.3	35.1	36.0	37.6	33.7	33.8

[1] 7-year average—1929-1935, inclusive.

Reference: Alabama Agricultural Experiment Station Circular 70, "Grades of Fertilizers for Corn and Cotton," pages 3 and 5, table 1, February 1935, Auburn, Alabama.

Table 66.—Nitrogen sources* test with corn, Stoneville, 1935-41.

Treatment	Bushels corn per acre							
	1935	1936	1937	1938	1939	1940	1941	Average
No nitrogen	15.3	9.7	11.2	18.7	21.4	48.5	35.1	24.1
Sodium nitrate	30.7	13.4	40.7	33.5	36.3	65.6	47.8	39.5
Ammonium nitrate	30.6	18.8	36.8	35.9	37.4	66.3	52.0	41.2
Ammonium sulphate	27.1	21.0	33.5	32.6	34.8	62.8	60.7	39.2
Cyanamid	15.3	9.7	30.7	34.1	33.9	60.7	52.7	36.9
Cottonseed meal**	29.3	18.7	22.7	30.1	30.0	—	48.4	29.9
(½ cottonseed meal (½ sodium nitrate	24.9	13.3	26.4	29.7	31.7	55.4	47.8	34.0

*30 pounds actual nitrogen per acre.
**Six-year average.

Reference: Mississippi Agricultural Experiment Station Service Sheets 172, 230, 275, and 300, State College, Mississippi; Mississippi Farm Research, February 1942.

Nitrogen Sources Test For Corn

Conducted by: Raymond Branch Experiment Station.

Conducted at: Raymond, Mississippi.

Period: 1926-1931, 1933-1935.

Purpose: To compare the various nitrogen sources for corn.

Soil: Vicksburg silt loam (bottom land).

Procedure and Conditions:

Fertilizer: 1926, 200 pounds 0-8-4 and nitrogen at rate of 22.5 pounds per acre. 1927-33, 300 pounds 16 percent superphosphate, 200 pounds 12 percent kainit, and nitrogen at the rate of 30 pounds per acre. 1934-35, 300 pounds 0-8-4 and 22.5 pounds nitrogen per acre. Fertilizer applied in water furrow and bedded on.

Planting date: Usually about May 15, latest planting date, June 5, 1930.

Variety of corn: Cocke's Prolific each year.

Table 67.—Nitrogen sources for corn at Raymond, Mississippi, 1926-35.

Nitrogen sources	Bushels per acre									
	1926	1927	1928	1929	1930	1931	1933	1934	1935	Av.
Nitrate of soda	50	37	29	38	30	35	37	31	31	35
Sulphate of ammonia	41	29	24	32	27	31	33	30	8	30
Leunasalpeter	42.	32	31	30	26	32	35	29	—	32
Calcium cyanamid	41	38	25	31	28	36	42	32	5	33
Calcium nitrate	50	40	33	34	29	37	40	34	—	37
Urea	47	41	26	34	29	34	44	29	9	34
No nitrogen (actual yield)	34	23	15	22	18	25	30	19	8	23

Note: No crop grown in 1932.

Reference Annual reports of the Raymond Branch Experiment Station.

Sources of Nitrogen For Corn

Conducted by: Northeast Louisiana Agricultural Experiment Station.

Conducted at: St. Joseph, Louisiana.

Period: 1933-1940.

Purpose: To compare different nitrogen fertilizers.

Procedure and Conditions: The fertilizer was applied when corn was approximately knee-high and at such rates as to give 30 pounds of actual nitrogen per acre.

Table 68.—**Sources of nitrogen used as side dressing to corn, Louisiana, 1933-40.**

Sources of nitrogen	Bushels ear corn per acre					
	1933	1934	1935	1937	1940	Average
Check	49.3	19.2	20.8	51.6	48.3	37.8
Chilean nitrate of soda	55.3	27.4	35.7	63.7	54.4	47.3
Arcadian nitrate of soda	—	—	35.5	62.6	57.5	51.8
Chilean nitrate of soda	—	—	35.7	63.9	—	49.8
Calnitro 16 percent	57.9	28.4	31.3	63.6	58.0	47.8
Nitrate of lime	—	26.3	33.4	60.9	—	40.2
Chilean nitrate of soda	—	27.4	35.7	63.9	—	42.3
Ammonium sulphate	62.0	28.2	25.3	63.8	54.6	46.8
Cyanamid	59.1	24.0	27.0	56.5	52.2	43.8
Ammonium nitrate	—	—	—	59.2	53.5	56.3
Uramon	—	—	—	—	54.4	—
Calnitro 20 percent	—	—	—	—	56.1	—

Reference: Northeast Louisiana Agricultural Experiment Station Biennial Report, 1939-1940, page 19, table 23, St. Joseph, Louisiana.

Comparative Efficiency of Nitrogen From Various Sources in the Production of Corn

Conducted by: North Louisiana Agricultural Experiment Station.

Conducted at: Calhoun, Louisiana.

Period: 1937-1940.

Purpose: To compare various nitrogen fertilizers for corn.

Procedure and Conditions: Nitrogen was applied at the rate of 32 pounds from each material, with 300 pounds of 18 percent superphosphate, and 60 pounds of muriate of potash per acre.

Table 69.—Comparative efficiency of nitrogen from various sources in the production of corn—Louisiana, 1937-40.

Sources of nitrogen	Bushels per acre				
	1937	1938	1939	1940	Average
Unfertilized	7.9	12.7	7.1	11.0	9.7
No nitrogen	7.1	11.5	10.9	10.2	9.9
Chilean nitrate of soda	26.1	31.9	33.5	27.2	29.7
Ammonium sulphate	29.1	28.2	33.9	25.4	29.2
Nitrate of soda and ammonium sulphate	27.5	31.9	32.3	26.6	29.6
Ammonium sulphate and lime	28.2	33.9	37.0	25.0	31.0
Nitrate of soda (S/D)	28.2	32.5	36.0	28.8	31.4
Ammonium sulphate (S/D)	29.8	28.6	34.7	29.0	30.5
Nitrate of soda and cottonseed meal	25.3	31.9	37.7	24.7	29.9
Arcadian nitrate of soda	23.9	30.3	36.0	28.2	29.6
Nitrate of soda	28.0	31.8	38.0	31.0	32.2
Cottonseed meal	26.3	26.7	34.1	24.2	27.8
Ammonium nitrate—limestone	22.8	33.7	42.6	29.4	32.2

Reference: North Louisiana Agricultural Experiment Station Biennial Report, 1939-1940, page 9, table 6, Calhoun, Louisiana.

Rate of Applying Nitrogen to Corn

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1935-1941.

Purpose: To compare the various rates of applying nitrogen to corn.

Table 70.—Rates of applying nitrogen to corn—Stoneville, 1935-41.

Treatment	Bushels corn per acre						
	1935	1936	1937	1939	1940	1941	Average
No fertilizer	11.5	10.0	11.1	21.8	47.9	30.9	22.2
50 lbs. sodium nitrate	12.5	12.8	16.1	24.7	49.3	32.4	24.5
100 lbs. sodium nitrate	18.1	13.5	20.2	28.9	52.9	39.2	28.8
150 lbs. sodium nitrate	22.3	15.2	27.5	32.9	57.9	41.7	39.5
200 lbs. sodium nitrate	29.9	19.0	33.4	37.9	61.4	43.5	37.5
250 lbs. sodium nitrate	35.7	21.1	33.7	40.6	63.8	45.8	40.1
300 lbs. sodium nitrate	36.5	20.4	35.9	41.0	67.2	50.3	41.8

Reference: Mississippi Agricultural Experiment Station Service Sheets 172, 195, 230, 275, 300, State College, Mississippi; Mississippi Farm Research, February 1942.

Time of Applying Nitrogen to Corn

Fall and spring application of sodium nitrate, ammonium sulphate
and cyanamid to corn

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1937-1941.

Purpose: To compare spring and fall applications of fertilizer to corn.

Table 71.—Fall and spring application of sodium nitrate, ammonium sulphate and cyanamid to corn—Stoneville, 1937-41.

Treatment	Bushels corn per acre					
	1937	1938	1939	1940	1941	Average
No nitrogen	18.1	21.7	6.2	49.2	30.3	25.1
Sodium nitrate—November	40.4	32.9	26.7	63.6	32.9	39.3
Ammonium nitrate—November	32.6	36.6	24.1	62.8	40.8	39.4
Cyanamid—November	32.0	35.1	19.7	59.6	39.2	37.1
Sodium nitrate—March	39.9	40.1	26.1	61.6	33.9	40.3
Ammonium nitrate—March	35.7	41.7	23.9	59.9	42.0	40.6
Cyanamid—March	39.3	38.0	20.8	61.2	38.7	39.6

Reference: Mississippi Agricultural Experiment Station, Mississippi Farm Research, February 1942, State College, Mississippi.

Time of Applying Nitrogen to Corn

Conducted by: Holly Springs Branch Experiment Station.

Conducted at: Holly Springs, Misssisippi.

Period: 1935-1940.

Purpose: To compare the various times of applying nitrogen to corn.

Soil: Grenada silt loam.

Table 72.—Time of application of nitrogen to corn—Holly Springs, 1935-40.

Treatment	Yield in bushels of corn per acre						
	1935	1936	1937	1938	1939	1940	Av.
150 lbs. sodium nitrate at planting	23.8	36.6	34.6	39.4	20.3	40.0	32.1
150 lbs. sodium nitrate at planting (No 0-8-4)	26.0	39.0	33.2	45.3	26.3	35.9	34.3
150 lbs. sodium nitrate 1 ft. high	24.0	37.6	31.2	41.6	25.0	37.3	32.8
150 lbs. sodium nitrate 2 ft. high	24.1	37.1	34.5	40.4	25.0	37.8	33.1
150 lbs. sodium nitrate 3 ft high	23.7	33.3	32.4	39.0	27.8	43.8	33.3
No sodium nitrate	22.9	30.5	29.0	22.6	14.4	18.7	22.9
75 lbs. sodium nitrate at planting, 75 lbs. 1 ft. high	23.8	40.3	34.0	48.5	26.1	47.6	36.7
75 lbs. sodium nitrate at planting, 75 lbs. 2 ft. high	25.4	36.9	35.7	47.9	32.8	48.3	37.8
75 lbs. sodium nitrate at planting, 75 lbs. 3 ft. high	24.6	37.5	37.9	47.0	32.8	45.3	37.6
150 lbs. sodium nitrate at tassel time	24.1	35.1	33.3	42.5	25.6	46.2	34.5

Reference: Mississippi Agricultural Experiment Station Information Sheet 236, "Corn Fertilizer in Mississippi," February 1941, State College, Mississippi.

Time of Applying Nitrate of Soda to Corn at Natchez, Mississippi

Conducted by: Natchez Branch Experiment Station.

Conducted at: Natchez, Mississippi.

Period: 1934-1937.

Purpose: To determine the effect of time of application of nitrate of soda on the yield of corn.

Soil: Memphis silt loam.

Procedure and Conditions: The same land was used each year. No crop other than corn was allowed to grow on the land.

Fertilizer: Source of nitrogen: Nitrate of soda only.

Dates of applying fertilizer: When applied before planting it was put under the rows 2 to 5 days before planting. As a side-dressing it was applied 40 days after planting.

Planting dates: April 15 with 4 to 5 days variation.

Spacing of plants in drill: 3 feet apart.

Size of plots: Five rows each 1/100-acre.

Width of rows: 32 inches.

Number of replications: 4.

Variety of corn used: Mosby.

Weather conditions: Favorable.

Table 73.—Time of applying nitrate of soda to corn—Mississippi, 1934-37.

Treatment	Bushels corn per acre				
	1934	1935	1936	1937	4-yr. Av.
Check.	12.0	9.9	12.7	14.8	12.3
100 lbs. under before planting	13.1	12.4	16.4	17.4	14.8
200 lbs. under before planting	19.4	16.9	35.6	23.1	23.8
100 lbs. side dressing, corn 40 days old	18.6	15.7	28.4	24.9	21.9
200 lbs. side dressing, corn 40 days old	23.2	20.4	34.2	24.9	25.9
100 lbs. under before planting	—	—	—	—	—
100 lbs. side dressing, corn 40 days old	21.2	21.0	38.1	29.3	27.4

Reference: Mississippi Agricultural Experiment Station Information Sheet 142, "Corn Fertilization," January 1938, State College, Mississippi.

Effect of Time of Applying Nitrate of Soda to Corn

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Different sections of Alabama.

Period: 1923-1924.

Purpose: To determine the effect of time of application of nitrate of soda on the yield of corn.

Procedure and Conditions: The general procedure in each experiment was to fertilize 12 one-twentieth-acre plots with the same amounts of superphosphate and muriate of potash, and all except the check plots with equal amounts of nitrate of soda. Superphosphate and muriate of potash were used at the rate of 200 pounds and 25 pounds per acre, respectively. These materials were applied in the drill just before planting. Nitrate of soda at the rate of 200 pounds per acre was applied as indicated.

Table 74.—Average results obtained from applying nitrate of soda to corn at different stages of growth—Alabama, 1923-24.

Plot no.	Amount per acre	Nitrate fertilization	Sandy soils (8 experiments)		Heavy soils (6 experiments)	
		Time of application	Per acre yield	Per acre increase	Per acre yield	Per acre increase
	Lbs.		Bu.	Bu.	Bu.	Bu.
1	0		17.8	—	14.6	—
2	200	At planting (broadcast)	28.0	11.3	25.0	9.6
3	200	At planting (drill)	31.3	14.6	28.0	12.6
4	0		16.8	—	17.6	—
5	200	35 days after planting	32.9	16.2	28.6	13.2
6	200	65 days after planting	30.1	13.4	27.9	12.5
	100	35 days after planting				
7	100	65 days after planting	31.8	15.1	29.8	14.4
8	0		15.4	—	16.0	—
	100	At planting				
9	100	35 days after planting	29.6	12.9	27.2	11.8
	100	At planting				
10	100	65 days after planting	30.3	13.6	28.1	12.7
	67	At planting				
	67	35 days after planting	—	—	—	—
11	67	65 days after planting	31.0	14.3	25.6	10.2
12	0		16.9	—	13.2	—

Reference: Alabama Agricultural Experiment Station Circular 52, "Fertilizer Experiments with Corn," pages 4, 5 and 12, table 4, December 1927, Auburn, Alabama.

Effect of Applying Fertilizer Under and Around Corn in Georgia

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1914-1918.

Purpose: To determine whether fertilizer should be applied under or around corn for best results.

Table 75.—Corn fertilizer placement test—Georgia, 1914-18.

Year	Amount of fertilizer	Bushels of grain when fertilizer was applied	
		Under	Around
1914	436	12.4	11.5
1915	390	23.5	25.6
1916	396	17.9	20.3
1917	250	12.6	12.4
1918	250	11.5	14.3
Average	—	15.6	16.8

Ga. Exp. Sta. Bul. 128.

Reference: Agricultural Education, Volume 10, No. 2, pages 27 and 28, table 19, Department of Agricultural Education, Clemson College, South Carolina.

Effect of Time of Applying Sodium Nitrate on Yield of Corn

Conducted by: South Carolina Agricultural Experiment Station.

Period: 1928-1930.

Purpose: To determine the effect of time applying sodium nitrate on yield of corn.

Table 76.—Effect of time of application of sodium nitrate on corn—South Carolina, 1928-30.

Amounts of nitrate of soda	Time of application	1928*	1929*	1930*	Average
0		17.9	24.8	13.8	18.2
200	At planting	24.7	32.2	26.0	27.8
200	Knee-high	30.1	40.3	29.1	32.9
200	Bunching to tassel	24.2	34.6	28.5	29.1
50	At planting				
150	Knee-high	29.2	39.7	26.9	21.6
100	Knee-high				
100	Bunching to tassel	28.5	36.2	28.3	30.8

*Average five farms 1928 and 1929, average seven farms 1930.

Reference: Agricultural Education, Volume 10, No. 2, page 28, table 21, Department of Agricultural Education, Clemson College, South Carolina.

LEGUMES AND BARNYARD MANURE AS FERTILIZERS FOR CORN

The Effect of Legumes and Commercial Nitrogen on the Yield of Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1930-1937.

Purpose: to compare a summer legume, a winter legume, and 200 pounds of sodium nitrate (equivalent to 30 pounds nitrogen per acre) as a source of nitrogen for corn.

Soil: Bottom soil.

Procedure and Conditions: The soybeans were planted in the drill with the corn and the Austrian winter peas were planted in the usual manner.

Table 77.—Legumes and nitrogen for corn at State College, Mississippi, 1930-37.

	Bushels per acre increase over no nitrogen								
	1930	1931	1932	1933	1934	1935	1936	1937	Av.
30 pounds nitrogen*	32.5	52.9	37.1	36.9	41.5	19.5	24.7	19.9	33.1
Corn with soybeans	33.0	29.6	25.7	32.7	29.5	12.3	14.9	18.0	24.1
Corn after Austrian winter peas	34.2	65.0	39.5	31.9	41.4	19.5	23.5	19.4	34.3
Corn with soybeans after Austrian winter peas	34.6	52.7	38.3	35.5	38.4	17.4	23.6	18.9	32.0
Without fertilizer or legume**	33.8	38.4	26.2	25.8	28.0	15.5	19.9	16.7	25.5

*Nitrogen applied as a side dressing.
**Actual yield.

Reference: Mississippi Agricultural Experiment Station Information Sheet 69, "Legumes and Corn Production," State College, Mississippi, and records from Agronomy Department, Mississippi Agricultural Experiment Station, State College, Mississippi.

Winter Cover Crop Test on Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1929-1937.

Purpose: To determine the effect of winter cover crops on corn without fertilizer.

Soil: Ocklocknee loam, very similar to Ocklocknee fine sandy loam except it has considerably less sand.

Procedure and Conditions:

Planting dates: cover crops, October 1 to 15; corn, May 10 to 20.

Fertilizer applied to cover crop: None.

Fertilizer applied to corn: None.

Seeding rates of cover crops: Vetch 20 to 25 pounds; Crimson clover 15 pounds; rye 5 pecks.

Spacing of corn: One stalk every 30 inches in 42-inch rows in all years except 1932 and 1933. These years, checked two stalks every 42 inches.

Variety of corn: Cocke's Prolific.

Date of turning cover crop: April 5 to 20.

The land on which this test was run has been in cultivation for forty years. The test was run on the same land continuously.

The seedbed for Crimson clover was pulverized with a Gee Whizz cultivator and covered lightly with V-harrow. Vetch and rye were shown in middles and covered by running middlebusters in middle.

Table 78.—Winter cover crop test on corn without fertilizer—State College, 1929-37.

Cover Crop	Bushels corn per acre									
	1929	1930	1931	1932	1933	1934	1935	1937	Av.	Increase over check
None — Check	27.2	22.4	37.4	27.4	37.2	28.4	22.1	29.9	29.0	—
Vetch	40.3	20.8	39.6	32.4	45.1	32.9	31.2	30.8	37.1	8.1
Crimson clover	32.9	20.4	38.0	31.4	44.9	28.4	25.8	30.5	31.5	2.5
Rye	24.9	17.2	40.0	28.3	38.9	30.1	19.5	28.0	28.4	—.6

No crop 1936, bad weather conditions.

Reference: Records from Mississippi Agricultural Experiment Station, Agronomy Department, State College, Mississippi.

Effect of Winter and Summer Legumes Upon Yield of Corn

Conducted by: Natchez Branch Experiment Station.
Conducted at: Natchez, Mississippi.
Period: 1934-1937.
Purpose: To determine effect of legumes on yield of corn.
Soil: Memphis silt loam.
Procedure and Conditions: Test was conducted on the same land each year.
Fertilizers:
Source of nitrogen: Nitrate of soda, soybeans and Austrian peas.
Source of phosphorus: None. Source of potash: None.
Method of applying fertilizer: Weighed for each row and applied by hand.
Dates of applying fertilizer: Approximately 10 days before planting.
Planting dates: April 15 with 4 or 5 days variation.
Spacing of plants in drill: Three feet apart.
Size of plots: Five rows, 1/100-acre each.
Width of rows: 32 inches.
Number of replications: 4.
Variety of corn used: Mosby.
Weather conditions: Favorable.

Table 79.—Effect of winter and summer legumes upon yield of corn—Natchez, 1934-37.

	Bushels corn per acre				
Treatment	1934	1935	1936	1937	4-yr. average
Check: no cover crop, no nitrate of soda	25.4	35.1	33.2	28.1	30.5
No cover crop, 200 lbs. nitrate of soda	29.9	44.5	44.6	34.1	38.3
Soybeans with corn	24.4	33.6	28.0	37.7	30.9
Austrian peas, no nitrate of soda	31.6	52.8	53.7	41.2	44.8
Austrian peas and soybeans with corn	26.5	37.6	56.3	39.4	40.0
Rye, no nitrate of soda	22.2	29.3	26.7	23.7	25.5
Rye, 200 lbs. nitrate of soda	25.2	42.5	37.2	33.5	35.1

Reference: Mississippi Agricultural Experiment Station Information Sheet 142, "Corn Fertilization," January 1938, State College, Mississippi.

Effect of Winter Cover Crops on the Yield of Corn

Conducted by: North Louisiana Agricultural Experiment Station.
Conducted at: Calhoun, Louisiana.
Period: 1935-1938.

Purpose: To determine the effects of winter cover crops on yield of corn. (See table 80).

Effect of Vetch Turned at Various Stages of Growth on Yield of Corn With Both 18-Inch and 36-Inch Spacing, Auburn, Alabama

Conducted by: Alabama Agricultural Experiment Station.
Conducted at: Auburn, Alabama.
Period: 1925-1929.

Purpose: To determine the effect of vetch on the yield of corn when the vetch is turned at various stages of growth. (See table 81).

Table 80.—Effects of winter cover crops on yield of corn—Louisiana, 1936-38.

Winter cover crops	Fertilization 1935-1938	1934-35 Cover crop yield		Residual effects—bushels corn per acre							
				1936		1937		1938		Average	
		Limed	Unlimed	Limed	Unlimed	Limed	Unlimed	Limed	Unlimed	Limed	Unlimed
No cover crop	500 lbs. 0-9-5	——	——	5.8	9.3	12.0	13.4	17.0	11.6	11.6	11.4
No cover crop	500 lbs. 5-9-5	——	——	14.5	10.4	20.9	17.4	18.3	11.4	17.8	13.1
Southern bur clover	500 lbs. 0-9-5	8.92	8.67	18.9	18.0	28.5	25.4	27.2	20.4	24.9	21.9
Austrian winter peas	500 lbs. 0-9-5	7.29	5.86	19.1	20.1	29.6	32.4	21.2	18.4	23.3	23.6
White Dutch clover	500 lbs. 0-9-5	NONE		9.2	10.0	12.3	15.7	13.4	13.5	11.6	13.0
Crimson clover	500 lbs. 0-9-5	10.78	11.36	13.5	15.8	21.2	24.7	16.7	17.9	17.2	19.2
Hairy vetch	500 lbs. 0-9-5	10.56	10.56	20.9	21.0	25.2	27.6	19.7	17.2	21.9	21.9
Hungarian vetch	500 lbs. 0-9-5	10.72	6.56	22.1	19.1	31.5	30.5	26.2	21.1	26.6	23.6
Oats	500 lbs. 0-9-5	4.35	2.08	9.7	10.0	11.1	9.0	18.6	15.3	13.1	11.5
Rye	500 lbs. 0-9-5	3.92	2.08	6.6	9.4	14.5	12.4	16.4	13.8	12.5	11.9

Reference: North Louisiana Agricultural Experiment Station Biennial Report 1927-38, page 8, table 6, Calhoun, Louisiana.

Table 81.—Yield of corn following vetch turned at various stages of growth with both 18-inch and 36-inch spacing—Alabama, 1925-29.

Plot	Fertilizer treatment pounds per acre	Date turning vetch	Planting date	1925*		1926		1927		1928		1929		Average	
				18 in.	36 in.	18 in.	36 in.	18 in.	36 in.	18 in.	36 in.	18 in.	36 in.	18 in.	36 in.
				Bushels per acre											
1	None		April 5	4.6	5.2	2.3	5.3	3.5	7.8	4.5	5.9	7.2	8.5	4.4	6.5
2	100 lbs. nit. soda		April 5	9.9	10.1	17.5	18.4	15.7	13.7	11.7	12.1	14.5	10.6	13.8	12.9
3	200 lbs. nit. soda		April 5	8.8	8.5	28.1	22.9	22.7	18.0	22.6	14.7	15.1	11.8	19.4	15.1
4	Vetch	March 25	April 5	8.3	11.6	26.1	17.9	31.1	23.8	13.9	13.9	31.4	30.9	22.6	19.6
5	None		April 5	3.4	6.9	4.7	8.9	7.7	11.0	7.8	8.7	12.3	13.4	7.2	9.7
6	200 lbs. nit. soda		April 20	7.6	9.7	31.9	33.2	23.0	21.1	22.0	15.7	26.2	24.6	22.1	20.8
7	300 lbs. nit. soda		April 20	7.9	11.3	38.6	37.0	26.9	22.9	26.3	16.9	27.2	20.6	25.4	21.7
8	Vetch	April 5	April 20	8.8	12.1	37.3	32.0	33.2	31.8	28.9	17.6	38.0	31.1	29.2	24.9
9	None		April 5	3.2	3.4	5.2	7.7	8.8	10.2	12.1	8.0	11.7	14.2	8.2	8.7
10	200 lbs. nit. soda		May 1	10.4	8.4	30.8	29.4	23.9	18.3	25.0	21.7	20.6	19.1	22.1	19.3
11	400 lbs. nit. soda		May 1	7.5	6.9	35.6	35.7	24.1	20.9	36.8	29.0	29.0	19.1	26.6	22.7
12	Vetch	April 11	May 1	4.5	8.3	41.1	37.5	35.1	29.6	34.6	22.8	32.3	31.1	29.7	25.8
13	None		April 5	4.2	5.1	7.2	9.6	10.9	12.2	13.7	7.8	7.2	16.4	8.6	10.1

*Yields in 1925 were very low due to drought.

Reference: Alabama Agricultural Experiment Station Bulletin 232, "Experiments with Legumes in Alabama," page 15, table 5, May 1930, Auburn, Alabama and correspondence.

Soil: Norfolk sandy loam.

Procedure and Conditions: All plots received 400 pounds of superphosphate and 50 pounds of muriate of potash per acre in 1925 and 1926. In the fall of 1926, plots 4, 8, and 12 received 1 ton 16 percent basic slag and 250 pounds of muriate of potash per acre. All other plots received the same fertilizer treatment in the spring of 1927. In the fall of 1931, all plots received 3200 pounds of 10 percent basic slag and 250 pounds muriate of potash per acre. (Mineral fertilizers now being applied every five years in heavy applications.)

One-fourth of the nitrate of soda was applied at planting time and three-fourths at knee-high.

The cover crop was planted after the first rain in September, never after October 15, at the rate of 25 to 30 pounds per acre.

Whatley's corn was used every year except 1932 when Indian Chief was planted. The corn was planted in 5-foot rows, 1 stalk per hill in drill, 18 and 36 inches. The plots 1/15 of an acre.

The field on which this test was run has been in cultivation 22 years. The test has been run continuously on the same land.

In January 1928 the vetch was winter-killed. The cover crops were not grazed. Austrian winter peas was the cover crop on this test for the first four years, but was discontinued on account of anthracnose. The yields from peas and vetch were about the same. The peas were seeded at 40 to 45 pounds per acre. (See table 81).

Fertilizer and Green Manure for Corn

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1937-1940.

Purpose: To determine the value of green manure and fertilizer on corn.

Soil: Cecil sand clay loam.

Procedure and Conditions: This test was conducted on plots 1/30-acre in size and replicated six times. The rows were 3½ feet wide and the plants were spaced 18 inches apart in the drill. One hundred pounds of nitrate of soda, 200 pounds of superphosphate and 32 pounds of muriate of potash were applied each year, at planting time, by hand. Corn was planted following Austrian winter peas. Hastings Prolific corn was used and was planted between May 1 and 15.

Table 82.—Fertilizer and green manure for corn—Georgia, 1937.40.

Source of nitrogen or cover crop	Air dry cut corn to the acre	Shelled corn to the acre
	Lbs.	Bu.
100 pounds nitrate of soda at planting	2,611	11.6
Summer legumes (soybeans) grown with corn	2,204	9.2
Winter legume (Austrian winter peas)	3,822	18.0
No nitrogen or cover crop	1,911	8.3

Reference: Georgia Agricultural Experiment Station Circular 126, "Corn Varieties, Hybrids, and Cultural Practices," page 11, table 9, March 1941, Experiment, Georgia.

The Effect of Cover Crops on the Yield of Corn

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1926-1933.

Purpose: To determine the effect of cover crops on the yield of corn.

Soil: Tifton sandy loam.

Procedure and Conditions:

Fertilizer: Five hundred pounds per acre of indicated analysis at planting time. No side dressing was applied. Nitrogen included in the fertilizer on one acre and omitted on the other.

Planting date of corn: Usually before April 10. The corn is usually planted in water furrow.

Variety of corn: Whatley's Prolific corn.

The cover crop was turned March 15. No fertilizer was applied to cover crops.

Table 83.—Yield of corn following cover crop—Georgia, 1926-33.

Fertilizer NPK	Cover crop	Yield in bushels per acre								
		1926	1927	1928	1929	1930	1931	1932	1933	Av.
No nitrogen in fertilizer										
0-10-4 and	Austrian winter peas	58.0	50.1	54.9	70.4	57.3	45.2	63.5	52.9	56.5
0-10-4 and	Monantha vetch	44.4	37.7	27.3	73.1	47.8	42.6	63.0	64.1	50.0
0-10-4 and	Hairy vetch	42.6	39.7	24.7	56.0	53.8	48.7	62.8	52.9	47.6
0-10-4 and	Rye	36.4	33.2	34.8	41.0	33.3	29.4	30.7	36.5	34.4
0-10-4 and	no cover crop	35.1	34.6	29.5	50.5	34.9	42.8	38.3	35.0	37.6
Nitrogen in fertilizer*										
2-10-4 and	Austrian winter peas	47.9	43.4	48.8	73.9	50.0	41.1	63.8	52.7	52.7
2-10-4 and	Monantha vetch	43.0	47.6	29.0	74.1	55.6	47.5	65.2	67.8	52.5
2-10-4 and	Hairy vetch	53.3	38.3	33.5	65.1	53.2	46.6	62.9	56.1	51.1
2-10-4 and	Rye	33.7	38.2	39.3	51.2	38.1	32.8	35.8	41.1	38.8
2-10-4 and	no cover crop	41.5	41.4	33.7	46.8	31.5	39.9	43.2	39.4	39.7

*The nitrogen here is reported in the form of ammonia. For nitrogen the formula should be read: 1 2/3-10-4. Georgia Bulletin 21.

Reference: Mississippi Agricultural Experiment Station Bulletin 303, page 14, table 14, "Winter. Legumes," August 1934, State College, Mississippi.

The Effect of Lime and Green Manure on the Yield of Corn

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1922-1929.

Purpose: To determine the value of lime and green manures with amounts of fertilizer varying from 200 pounds through 400 pounds per acre.

Procedure and Conditions: A 3-year rotation of cotton, corn and oats was used in this experiment. One and one-half tons of ground limestone are applied once in 3 years to the limed plots.

Two hundred, 300, and 400 pounds of 1 2/3-8-6 formula (nitrogen, phosphorus, and potash) was applied.

Whatley's Prolific corn was planted.

Previous to 1926 a cover crop of cowpeas was turned under following oats in the rotation. No winter cover crops were used. From 1926 through 1929 a winter green manure of Austrian winter peas was used in addition to the cover crop of cowpeas.

Although cotton, corn and oats were used in the rotation in the order named, supplemental studies indicate that a better arrangement would be cotton, oats and corn so that the summer cover crop of cowpeas and the winter cover crop of Austrian peas following oats would precede corn instead of cotton.

Table 84.—The effect of lime and green manure on the yield of corn—Georgia, 1922-29.

Plot treatment	Bushels per acre								
	1922	1923	1924	1925	1926	1927	1928	1929	8-yr. av.
Green manure and 200 lbs. fertilizer	42.6	27.9	35.9	34.2	26.2	26.3	27.4	33.7	31.8
Lime, green manure and 200 lbs. fertilizer	35.2	29.5	28.7	30.0	32.7	17.9	24.6	34.8	29.2
Lime and 200 lbs. fertilizer	23.4	25.3	26.9	33.5	23.8	9.4	19.4	32.1	24.2
Green manure and 300 lbs. fertilizer	40.9	32.0	38.7	38.4	28.6	26.9	29.1	45.5	35.0
Lime, green manure and 300 lbs. fertilizer	36.4	33.3	33.0	40.6	37.8	20.0	30.3	51.6	35.4
Lime and 300 lbs. fertilizer	33.8	26.1	27.3	33.3	27.5	10.2	14.4	44.5	27.1
Green manure and 400 lbs. fertilizer	34.4	40.2	40.0	45.1	35.8	33.3	31.9	58.6	39.9
Lime, green manure and 400 lbs. fertilizer	37.0	36.9	35.2	41.6	37.2	21.2	34.5	51.6	36.9
Lime and 400 lbs. fertilizer	37.5	32.3	24.8	35.0	28.2	13.4	14.3	39.5	28.1

Reference: Georgia Coastal Plain Experiment Station Bulletin 14, "Corn Production in the Coastal Plain of Georgia," pages 11 and 15, table 5, June 1930, Tifton, Georgia.

Effect of Crimson Clover Removed and Turned on the Yield of Corn

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Knoxville, Tennessee.

Period: 1908-1912.

Purpose: To determine the value of crimson clover as a manure crop preceding corn.

Soil: Rather heavy loam, in good physical condition but of varying degrees of productivity.

Procedure and Conditions: In all the trials, care was taken both in the soil preparation and in the planting, to make the conditions as much alike as possible, so that the one variable factor was in the clover crop.

The land was relatively poor, and corn was grown continuously for 5 seasons, both following crimson clover and where none was grown. All plots received annually 200 pounds of superphosphate and 50 pounds of muriate of potash per acre. The corn crops were cut and removed, after which the land was disked and 4 plots, Nos. 3, 4, 6, and 7, were sown to crimson clover. Two other plots, Nos. 5 and 8, were left bare through the winter. The clover crops varied greatly from good to poor, but exerted a marked effect on the yield of corn.

Table 85.—Acre yields of corn following crimson clover—Tennessee, 1908-12.

Plot No.	Corn crop	Disposition of clover crop	Yield of corn	
			Grain	Stover
			Bushels per acre	Tons per acre
5 and 8	1908	None grown	34.1	1.17
	1909	None grown	40.2	1.21
	1910	None grown	29.7	1.10
	1911	None grown	24.8	1.21
		Average	30.8	1.19
3 and 6	1908	Removed	34.1	1.24
	1909	Removed	58.9	1.69
	1910	Removed	46.5	1.49
	1911	Removed	32.9	1.51
	1912	Removed	36.8	1.51
		Average	41.8	1.49
4 and 7	1908	Turned under	34.0	1.11
	1909	Turned under	59.4	1.65
	1910	Turned under	41.1	1.51
	1911	Turned under	44.0	1.64
	1912	Turned under	38.7	1.59
		Average	43.4	1.50

Reference: Tennessee Agricultural Experiment Station Bulletin 142, "The Effects of Various Legumes on the Yield of Corn," pages 4 and 5, table 1, February 1930, Knoxville, Tennessee.

The Effect of Manure on Corn With and Without Cowpeas

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Jackson, Tennessee.

Period: 1910-1930.

Purpose: To determine the effect of cowpeas when sown broadcast at the last cultivation of corn with and without manure.

Soil: Silt loam of moderate productivity.

Procedure and Conditions: Plots 14 and 15 were planted continuously to corn without cowpeas. Plots 16 and 17 were planted continuously to corn, and Whippoorwill cowpeas were sown broadcast at the rate of ½-bushel per acre in the corn. The average date of planting of the corn was April 26. The cowpeas were generally sown the latter part of June. One plot of each set (Nos. 14 and 16) were manured every year at the rate of 5 tons per acre. Plots 15 and 17 were unmanured. All the crops, both grain and stover, were removed annually. (See table 86).

The Value of Applying Manure in Various Places in a Corn-Wheat-Clover Rotation

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Soil and Crops Experiment Farm at Lafayette, and the Sand Field near Culver.

Period: 8 years, 1925-1934, at the Sand Experiment Field; 16 years, 1919-1934, at the Soil and Crops Experiment Farm.

Purpose: To determine the most efficient place for applying manure in a 3-year rotation of corn, wheat and mixed clover, and alfalfa hay.

Soil: Crosby silt loam, a heavy soil, at the Soil and Crops Experiment Farm. Plainfield fine sand at the Sand Field. (Continued bottom page 76).

Table 86.—**Effect of the yield of corn produced by cowpeas sown broadcast at the last cultivation of the corn—Tennessee, 1910-30.**

		No cowpeas grown			Cowpeas at last cultivation			
Year	Manure per acre	Plot	Yield of corn. No cowpeas grown		Plot	Yield of corn. Cowpeas sown last cultivation		Remarks
			grain	Stover		grain	Stover	
			Bu.	Tons		Bu.	Tons	
1910	5 tons	14	38.4	1.60	16	39.4	1.68	Light crop
	None	15	34.4	1.44	17	34.9	1.40	of cowpeas
1911	5 tons	14	25.0	1.08	16	22.9	1.10	Good crop
	None	15	23.0	0.90	17	13.2	0.78	of cowpeas
1912	5 tons	14	54.3	1.86	16	50.0	1.76	
	None	15	40.7	1.54	17	47.1	1.84	
1913	5 tons	14	43.2	1.30	16	50.7	1.34	
	None	15	29.2	0.92	17	37.8	1.00	
1914	5 tons	14	26.8	1.72	16	30.0	1.80	Cowpeas made
	None	15	25.0	1.24	17	20.7	1.20	little growth
1915	5 tons	14	46.4	1.42	16	53.9	1.54	Cowpeas made
	None	15	31.0	0.80	17	27.8	0.74	little growth
1916	5 tons	14	45.0	2.24	16	47.0	2.08	
	None	15	33.5	1.32	17	28.5	1.56	
1917	5 tons	14	47.9	2.20	16	43.6	1.82	
	None	15	28.2	1.24	17	29.3	1.38	
1918	5 tons	14	30.4	1.26	16	32.1	1.22	No stand of
	None	15	23.6	0.62	17	25.0	0.62	peas obtained
1919	5 tons	14	45.7	1.62	16	44.3	1.71	No cowpeas
	None	15	25.4	0.78	17	28.2	0.82	sown. Corn
1920	5 tons	14	48.9	1.40	16	44.3	1.34	badly blown
	None	15	26.4	0.76	17	27.9	0.76	down. Cowpeas
1921	5 tons	14	55.7	2.06	16	59.3	1.98	made very
	None	15	27.1	0.93	17	30.0	0.93	little growth
1922	5 tons	14	55.7	1.58	16	57.9	1.53	
	None	15	31.4	0.96	17	32.5	0.96	
1923	5 tons	14	42.2	1.58	16	46.4	1.61	
	None	15	21.4	0.79	17	30.0	0.92	
1924	5 tons	14	39.3	1.92	16	33.6	1.94	
	None	15	15.7	1.11	17	17.1	1.26	
1925	5 tons	14	55.7	1.44	16	60.0	1.74	
	None	15	33.6	0.76	17	36.1	0.96	
1926	5 tons	14	42.9	2.66	16	50.0	2.38	
	None	15	28.6	1.12	17	34.3	1.22	
1927	5 tons	14	49.3	1.96	16	49.3	2.00	
	None	15	23.6	0.90	17	22.1	1.12	
1928	5 tons	14	49.6	2.16	16	50.0	2.24	
	None	15	25.7	1.26	17	26.4	1.30	
1929	5 tons	14	48.6	1.48	16	51.4	1.50	
	None	15	25.7	0.74	17	31.1	0.90	
1930	5 tons	14	19.3	1.20	16	25.7	1.24	
	None	15	13.6	0.70	17	17.9	0.70	
Average	5 tons	14	43.3	1.70	16	44.8	1.69	
	None	15	27.0	0.99	17	28.5	1.07	

Reference: Tennessee Agricultural Experiment Station Bulletin 137, "Influence of Cowpeas Crop on Yield of Corn," pages 14 and 15, table 4, March 1927, Knoxville, Tennessee, and Tennessee Agricultural Experiment Station Bulletin 149, "Fertilizers and Manure for Corn," Knoxville, Tennessee.

Procedure and Conditions: Both fields were limed at the rate of 2 tons of ground limestone per acre when the experiments were begun. In each of these tests manure is applied at different places in the rotation at the rate of 6 tons per acre on the Crosby silt loam and 5 tons on the Plainfield fine sand. The manure used on the heavy soil is well mixed horse manure and that on the sandy soil is fresh well-mixed cow manure from a herd which is fed concentrates throughout the year. In all cases the manure is prepared in such a way as to be as nearly constant in composition as possible.

Table 87.—The value of applying manure in various places in a corn-wheat-clover rotation—Indiana, 1925-34.

Place of application for manure	Average yield per acre							
	Soils and Crops Experiment Farm Average 16 years, 1919-34 6 tons manure per acre per rotation				Sand Experiment Field Average 8 years, 1925-34 5 tons manure per acre rotation			
	Corn				Corn			
	Grain	Stover	Wheat	Hay	Grain	Stover	Wheat	Hay
None	42.8	2917	26.4	3350	30.2	726	6.6	1835
Plowed under for corn	56.9	3626	30.6	3696	39.8	755	7.8	2273
On corn after planting	54.0	3456	32.4	3829	41.3	848	10.3	2845
None	45.4	2925	25.5	2538	32.0	533	5.9	2021
2/3 plowed under for corn 1/3 on wheat in winter	57.5	3492	31.7	4239	—	—	—	——
1/2 plower under for corn 1/2 on wheat in winter	—	——	—	——	40.2	1005	11.5	2858
None	43.6	2877	25.3	3386	31.2	543	6.1	2235
On young clover after wheat was harvested	54.8	3378	30.0	4247	38.3	535	7.0	2601
On second growth clover after hay was harvested	57.0	3465	30.6	3679	39.7	615	8.8	2560
None	44.3	2938	25.5	3223	29.7	486	5.2	1665

Reference: Indiana Agricultural Experiment Station Bulletin 398, "Manure Increases Farm Income," pages 15, 16 and 17, tables 16 and 17, March 1935, Lafayette, Indiana.

Summer Legumes Cut and Turned Under as a Fertilizer for Corn

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1930-1936.

Purpose: To determine the effect of soybeans on the following crop when cut off for hay, or when plowed under.

Soil: Bench land, classed as Denham silt loam. It was formerly classed as Memphis silt loam.

Procedure and Conditions: All the plots were fertilized each year before planting with 300 pounds of 16 percent superphosphate, 50 pounds nitrate of soda, and 50 pounds of muriate of potash per acre.

Cocke's Prolific, a vigorous-growing, medium late, prolific variety of corn was used in this experiment. Ototan soybeans, or another variety of the same spreading and viney type, were used.

The planting was done with a one-horse planter on which there was a duplex hopper with six cups on a side. This planted hills of corn and beans in alternation, the hills being 27 inches apart. The rows were four feet apart. There were from three to five kernels of corn and six or eight beans dropped in a hill. The seeds of both were scattered somewhat as they fell. In 1933, the corn plants were thinned to two in a hill. Other years they were thinned to one stalk. The beans were not thinned. Good stands were secured, as a rule, but they were damaged somewhat by birds and insects. Some replanting was done nearly every year.

Five-row lots containing approximately 1/20-acre each were used with four or five replications. Only the three middle rows of the plots were harvested for experimental weights. The corn was planted about March 20 each year. This is considered a good date for planting corn in the locality.

In 1929, 4263 pounds of hay per acre were grown on the bean plots. In 1930 all the plots were planted in corn, and in 1931 beans were again planted on a part of the plots, and so on, a 2-year rotation being followed. After 1931, the corn alone plots were allowed to lie fallow when the other plots were in beans. In 1934 all the plots were damaged by a tropical storm in June, and in 1936 the weather was too dry for good corn production.

The season of 1930 was drier than a normal season. The rainfall during the growing season of 1932 with the exception of May which was rather wet was nearly normal.

Table 88.—Corn yield after soybeans were turned under or cut for hay—Louisiana, 1930-36.

Year	Plots that grew no beans	Plots with beans turned under		Plots with beans cut off for hay	
	Bushels corn per acre	Bushels corn per acre	Percent gain from beans	Bushels corn per acre	Percent gain from beans
1930	19.6	30.5	55.6	24.1	22.9
1932	19.1	50.2	162.3	33.3	74.3
1934	10.6	21.0	98.1	19.5	83.9
1936	6.0	23.4	284.2	13.7	124.0

Reference: Louisiana Agricultural Experiment Station Bulletin 265, "Effect of Soybeans on Corn Yields," pages 3, 4, 7, 8, 26, 27, and 28, July 1935, Baton Rouge, Louisiana.

Effect of Cowpeas and Soybeans Turned Under and Cut for Hay on Yields of Corn

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville Arkansas.

Period: 1921-1924.

Purpose: To determine the effect of legumes, whether cut for hay or turned under, on the yield of corn.

Soil: Clarksville silt loam of medium fertility and capable in good years of making rather heavy crops of grain.

Procedure and Conditions: In 1921 and again in 1923 various legumes were planted, some being turned under and some cut for hay, oats being used as the check crop. In 1922 and again in 1924 these plots were planted to corn and the effect of the legumes whether cut for hay or turned under, was measured by the yield of corn.

These tests have been conducted for the most part without inoculation. In 1923 one of the three series planted was inoculated with soil from land where soybeans were grown the previous year. An examination of the roots of the crop showed practically as much inoculation in the series not inoculated as where this inoculation was given. On the Experiment Station Farm, many soybean plants have shown inoculation when grown on land where no soybeans were ever grown before. Therefore, it seems really unnecessary to inoculate soybeans, although it is possible greater fixation of nitrogen will be obtained were this done.

Table 89.—Increase in yields of corn following soybeans and other legume crops—Arkansas, 1921-24.

Crop 1921 and 1923	Bushels corn per acre 1922	Bushels corn per acre 1924
1. Oats — check	31.48	35.6
2. Cowpeas plowed under	52.51	59.6
3. Soybeans plowed under	52.83	56.2
4. Oats — check	34.49	35.8
5. Cowpeas cut for hay	47.43	43.3
6. Soybeans cut for hay	43.65	35.6
7. Oats — check	34.86	35.8
8. Velvet beans plowed under	44.40	44.1
11. Velvet beans cut for hay	46.23	39.7
12. Oats — check	33.60	35.1
14. Oats followed by cowpeas turned under	48.29	53.3
15. Oats followed by soybeans turned under	43.06	41.0
16. Oats — check	34.80	36.5

Reference: Arkansas Agricultural Experiment Station Bulletin 199, "Variety and Rotation Experiments with Soybeans," pages 3, 8, 17 and 18, table 8, Fayetteville, Arkansas.

Effect of Cowpeas-Corn Rotation on Yield of Corn

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Knoxville, Tennessee.

Period: 1905-1924.

Purpose: To determine the effect of cowpea crop on the corn crop of the following year.

Soil: Gravelly loam derived from the dolomite formation, a good represenative of a prominent soil type of East Tennessee.

Procedure and Conditions: The soil was in a good state of productivity at the outset, but was not well enough supplied with plant food, nitrogen in particular, to maintain high yields without manuring. Late applications of superphosphate and muriate of potash were made under each of the experimental conditions, in order that the nitrogen supply might be the limiting factor so far as plant food was concerned.

The plots received the following treatments:

Plots 10 and 11, Continuous corn. No cowpeas grown.
Plot 13, Bare fallow in odd years. Corn in even years. No cowpeas grown.
Plots 14 and 15, Cowpeas in odd years. Corn in even years. Cowpeas removed as hay.
Plots 16 and 17, Cowpeas in odd years. Corn in even years. Cowpeas turned in spring.

Plots 18 and 19, Cowpeas in odd years. Corn in even years. Cowpeas turned under in fall.

Table 90.—**Yields per acre of cowpea hay and corn for the 20-year period 1905-1924. Fertilizer treatments the same under all conditions—Tennessee, 1909-24.**

	Plots 10 & 11 continuous corn. No cowpeas grown	Plot 13 Bare fallow in odd yrs. Corn in even yrs. No cowpeas grown	Plots 14 and 15 Cowpeas in odd yrs. Corn in even yrs. Cowpeas removed for hay		Plots 16 and 17 Cowpeas in odd yrs. Corn in even yrs. Cowpeas turned under in spring		Plots 18 and 19 Cowpeas in odd yrs. Corn in even yrs. Cowpeas turned under in fall	
Year	Corn Bushels	Corn Bushels	Cowpea hay Tons	Corn Bushels	Cowpea hay Tons	Corn Bushels	Cowpea hay Tons	Corn Bushels
1905	—	—	1.86	—	1.81	—	1.54	—
1906	49.4	58.9	—	53.9	—	58.7	—	70.1
1907	58.9	—	1.15	—	1.12	—	1.18	—
1908	41.0	43.7	—	40.9	—	50.2	—	43.3
1909	52.7	—	1.94	—	2.26	—	1.66	—
1910	45.5	35.1	—	43.4	—	57.1	—	51.7
1911	45.2	—	1.55	—	1.87	—	1.44	—
1912	16.1	17.2	—	20.7	—	33.2	—	35.0
1913	24.6	—	0.65	—	0 72	—	0.81	—
1914	35.8	37.1	—	39.7	—	44.7	—	46.6
1915	27.9	—	0.68	—	0.76	—	0.78	—
1916	27.9	21.4	—	36.5	—	39.5	—	41.7
1917	—	—	1.31	—	1.28	—	1.40	—
1918	23.2	15.7	—	30.7	—	34.3	—	27.2
1919	17.3	—	1.49	—	1.79	—	1.35	—
1920	18.7	19.9	—	26.7	—	40.1	—	32.8
1921	23.6	—	1.03	—	1.35	—	1.21	—
1922	13.2	8.6	—	18.9	—	27.2	—	24.6
1923	14.6	—	0.57	—	0.83	—	0.83	—
1924	18.2	13.6	—	28.8	—	39.3	—	32.2
Average	28.6*	27.1	1.22	34.0	1.36	42.4	1.27	40.5

*Ten year average of even years, or the years in which corn was grown on the plots other than the check. The average for the odd years on the check plot was 33.1 bushels.

Reference: Tennessee Agricultural Experiment Station Bulletin 137, "Influence of Cowpeas Crop on Yield of Corn," March 1927, Knoxville, Tennessee.

Experiments on Cowpea-Corn Rotation

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Knox county.

Period: 1906-1917.

Purpose: To determine the effect of planting soybeans with the corn.

Soil: Chickamauga, or "rotten" limestone.

Procedure and Conditions: These experiments differ from those at Knoxville in two important particulars; first, that data are available for both lime and unlimed conditions, and secondly, that comparative data were obtained from light applications of farmyard manure.

Another difference in these experiments is that cowpeas were used in one set and soybeans in another. With regard to these summer legumes no material conclusions seems warranted other than that their behavior was much the same under the various conditions and their effects on corn were similar.

Table 91.—Yield per acre of legume (cowpeas and soybeans) hay and of corn under various experimental conditions in Knox county, Tennessee, 1906-17.

Crop, plot Disposition of legume manure and fertilizer	Year	Limed		Unlimed		Average	
		Corn bus.	Legume hay tons	Corn bus.	Legume hay tons	Corn bus.	Legume hay tons
6, 7	1907	—	—	—	—	14.8	—
Continuous corn. No legumes.	1909	64.9	—	55.0	—	60.0	—
Six tons manure per acre	1911	45.7	—	35.0	—	40.4	—
every two years, beginning	1913	31.4	—	27.5	—	29.5	—
1906-30 tons in all	1914	43.0	—	39.7	—	41.4	—
	1916	48.3	—	35.1	—	41.7	—
	Av.	46.7	—	38.5	—	38.0	—
9, 16	1907	—	—	—	—	22.9	—
Continuous corn, No legumes.	1909	51.4	—	45.0	—	48.2	—
200 pounds phosphate, 25	1911	31.4	—	26.9	—	29.2	—
pounds potash per acre	1913	15.4	—	12.7	—	14.1	—
every two years, beginning	1914	32.5	—	26.4	—	29.5	—
1906	1916	24.2	—	13.3	—	18.8	—
	Av.	31.0	—	24.9	—	27.1	—
10, 12	1906	—	—	—	—	—	1.59
Soybeans on plot 10.	1907	—	—	—	—	23.7	—
Cowpeas on plot 12.	1908	—	—	—	—	—	1.42
Removed as hay. Phosphate	1909	57.9	—	53.6	—	55.8	—
and potash as for plots	1910	—	1.11	—	0.60	—	0.86
9 and 16	1911	48.4	—	36.8	—	42.6	—
	1912	—	1.37	—	0.75	—	1.68
	1913	25.3	—	20.7	—	23.0	—
	1914	38.2	—	33.8	—	36.0	—
	1915	—	1.24	—	0.90	—	1.07
	1916	38.6	—	25.0	—	31.8	—
	1917	—	1.22	—	0.89	—	1.06
	Av.	41.7	1.24	34.0	0.79	35.5	1.18
11, 13	1906	—	—	—	—	—	1.59
Soybeans on plot 11	1907	—	—	—	—	25.7	—
Cowpeas on plot 13 turned	1908	—	—	—	—	—	1.58
under, phosphate and	1909	64.5	—	53.6	—	59.1	—
potash as for plots 9	1910	—	1.08	—	0.61	—	0.85
and 16	1911	57.1	—	41.8	—	49.5	—
	1912	—	1.43	—	0.71	—	1.07
	1913	26.9	—	21.4	—	24.2	—
	1914	43.9	—	36.1	—	40.0	—
	1915	—	1.28	—	0.92	—	1.11
	1916	47.2	—	31.5	—	39.4	—
	1917	—	1.30	—	0.84	—	1.07
	Av.	47.9	1.27	36.9	0.77	29.7	1.21

Reference: Tennessee Agricultural Experiment Station Bulletin 137, "Influence of Cowpeas Crop on Yield of Corn," pages 7 and 8, table 2, March 1927, Knoxville, Tennessee.

The Effect of Picking Soybeans for Seed Versus Cutting Them for Hay Upon Corn Production

Conducted by: Coastal Plain Experiment Station.
Conducted at: Rocky Mountain, North Carolina.
Period: 1927-1935.

Purpose: To determine the effect of picking soybeans for seed versus cutting them for hay upon corn production.

Table 92.—A summary from 17 duplicate fertilizer treatments in which one series was picked for seed and the other series cut for hay—North Carolina, 1927-35.

	Average yield of corn per acre					
	1927	1929	1931	1933	1935	5-yr. av.
Soybeans picked for seed	37.9	43.3	42.2	36.8	44.3	40.8
Soybeans cut for hay	33.5	28.6	29.0	23.8	26.9	28.4

Reference: Suggestive Helps for Teachers of Agriculture No. 6, page 21, Department of Education, North Carolina State College, Raleigh, North Carolina.

Summer Legumes Interplanted in Corn as a Corn Fertilizer

Influence of summer legumes on corn yields

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1938-1941.

Purpose: To determine the influence of summer legumes on corn yields.

Soil: Sandy loam.

Procedure and Conditions: A test to determine the effect of summer legumes on corn yields was started in 1938. The summer legumes used were soybeans, cowpeas and crotalaria. In determining the yields an average was taken of eight replications.

One series of plots was planted to corn alone without fertilizer, another was planted to corn alone and fertilized with 30 pounds of nitrogen per acre. Another series of plots using soybeans, cowpeas and crotalaria planted with the corn, and another series of plots using soybeans, cowpeas and crotalaria planted when the corn was laid by. Another series of plots was planted two rows of corn and two rows soybeans. Corn and soybeans were alternated each year, soybeans were turned and corn planted on rows where soybeans were turned.

The 1938 yields should not be used in computing an average of results of this test because the effect of the summer legume is not shown due to the fact that all plots received the same treatment in 1937. All plots were unfertilized except the plots receiving 30 pounds nitrogen.

Table 93.—Influence of summer legumes on corn yields—Stoneville, 1938-41.

Treatment	Bushels per acre				
	1938*	1939	1940	1941	Average
Corn alone	23.4	12.0	13.7	10.1	11.9
Corn and 30 lbs. nitrogen	34.9	29.2	30.6	25.0	28.3
Corn and soybeans	23.7	26.9	36.3	41.4	34.9
Corn and cowpeas	21.3	25.7	31.6	17.2**	24.8
Corn and crotalaria	25.6	25.0	26.2	35.4	28.9
Corn and soybeans later	27.2	17.2	19.8	19.0	18.7
Corn and cowpeas later	27.2	17.4	17.1	13.3**	15.9
Corn and crotalaria later	25.3	16.0	15.3	19.6	17.0
2 rows corn and 2 rows soybeans	15.3	19.6	25.4	31.0	25.3

*1938 yields not included in averages.

**Cowpeas failed to germinate to a stand in 1940; therefore, maximum increased corn yields were not obtained in 1941.

Reference: Mississippi Agricultural Experiment Station Service Sheet 286, "Corn Production in the Yazoo-Mississippi Delta," February 1940, State College, Mississippi. Observations at Delta Branch Station, Stoneville, Mississippi, and Mississippi Farm Research, February 1942.

Effect of Interplanting Legumes in Corn

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Main Station, Fayetteville, Arkansas.
Cotton Branch Station, Marianna, Arkansas.
Scott Experimental Field, Scott, Arkansas.

Period: Main Station, 1927-1938.
Cotton Branch Station, 1926-38.
Scott Experimental Field, 1926-1931.

Purpose: To determine the effect of interplanting legumes in corn.

Soil: Main Station: Clarksville silt loam predominating.
Cotton Branch Station: Lintonia fine sandy and silty loam and Sharkey clay.
Scott: Pulaski fine sandy loam.

Procedure and Conditions: In 1926 a series of tests were begun at the Scott Experiment Field and Cotton Branch Station and in 1927 at the Main

Table 94.—Acre yields of corn interplanted with legumes by methods of planting legumes—Arkansas, 1926-33.

Methods of planting legumes in corn	Average yield of corn		
	Scott Field 1926-1931	Cotton Branch 1926-1932	Main Station 1927-1932
	Bushels	Bushels	Bushels
Check (corn alone)	34.8	—	—
Cowpeas			
One hill between corn hills	28.1	19.3	36.6
Two hills between corn hills	26.2	15.9	40.3
Drilled in normal middles	30.3	22.1	46.7
Broadcast in normal middles	29.6	21.9	45.9
Check	25.7	—	—
Soybeans			
One hill between corn hills	23.4	20.7	34.9
Two hills between corn hills	23.1	21.7	31.1
Drilled in normal middles	29.8	33.1	41.8
Broadcast in normal middles	31.2	31.8	41.0
Check	31.2	—	—
Velvet beans			
One hill between corn hills	29.0	24.4	30.6
Two hills between corn hills	29.5	18.8	21.7
Drilled in normal middles	37.7	23.9	36.8
With soybeans in normal middles	30.9	24.8	35.8
Check	30.8	—	—
Mung beans			
One hill between corn hills	27.6	20.2	27.9
Two hills between corn hills	28.5	18.9	26.3
Drilled in normal middles	40.4	15.3	30.1
Broadcast in normal middles	41.6	16.9	32.2
Check	41.9	—	—
Mung beans in wide middles	36.8	19.1	35.9
Cowpeas, in wide middles	31.1	21.2	35.6
Soybeans, in wide middles	24.9	22.9	31.6
Average of checks	32.8	25.0	41.7

Station to determine the effect of corn interplanted with summer legumes. These tests were conducted until 1931 at Scott, and 1932 at the Cotton Branch Station and the Main Station. After 1932 the tests were revised and conducted at the Cotton Branch Station and the Main Station. The same type test was conducted at the Scott Experimental Field from 1926-31. The results are presented in tables 94, 95, and 96.

One-tenth acre plots were used. The normal width rows were 44 inches and the wide rows were 58 inches. The corn was not fertilized. In these tests Brabham cowpeas, Otootan soybeans, Early Speckled velvet beans, and Mung beans were used.

In connection with these tests the amount of dry forage was obtained. At Scott Experimental Field the yield of hay was determined for 4 years, 1926-30; at the Cotton Branch Station for the years 1928, 1929, 1930, and 1933, and at the Main Station from 1927-1933. Results are tabulated in table 96.

Table 95.—Acre yields of corn interplanted with legumes by methods of planting legumes—Arkansas, 1926-38.

	Acre yield of corn per acre		
	Scott Field	Cotton Branch Station	Main Station
	1926-1931	1933-1938	1933-1938
	Bushels	Bushels	Bushels
Check (corn alone)	32.8	—	—
Cowpeas			
In rows with corn	27.1	9.3	11.6
In wide middles	29.9	12.7	20.4
In normal middles	31.1	9.2	19.3
In rows with corn	—	6.0	10.2
Soybeans			
In row with corn	23.2	13.4	14.2
In wide middles	28.7	18.9*	20.6
In normal middles	24.9	22.1	19.2
In rows with corn	—	18.7	13.2
Cowpeas in rows with corn	—	17.2	10.2
Soybeans in rows with corn	—	16.5	10.7
Cowpeas in normal middles	—	14.9	14.8
Soybeans in normal middles	—	12.9	13.6
Velvet beans			
In rows with corn	29.2	—	—
In normal middles	34.3	—	—
Mung beans			
In rows with corn	28.1	10.8	8.1
In wide middles	41.0	12.7	10.6
In normal middles	36.8	9.9	10.8
In rows with corn	—	8.9	10.9
Mung beans in wide middles	—	10.6	14.8
Cowpeas in wide middles	—	13.2	17.1
Soybeans in wide middles	—	15.2	18.6
Average of checks	—	12.5	16.9

*Prior to 1933, two hills of legumes were grown between corn hills on these plots. Good stand and growths were obtained. The residual effect of the method of planting, stand, and growths are reflected in the yields in the years following the change of the planting plan.

Table 96.—Acre yields of dry legume forage from legumes interplanted in corn by methods of planting legumes—Arkansas, 1926-38.

Method of planting legumes in corn	Yield of dry forage per acre																	
	Scott Experimental Field					Cotton Branch Station					Main Station							
	1926	1927	1929	1930	Av.	1928	1929	1930	1933	Av.	1927	1928	1929	1930	1932	1933[2]	1937[3]	Av.
	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
Cowpeas																		
One hill between corn hills	1.05	0.80	1.80	1.51	1.29	0.87	0.65	0.59	0.56	0.66	0.75	0.47	1.20	0.59	0.42	1.39	1.07	0.84
Two hills between corn hills	1.18	0.85	1.76	1.60	1.34	1.14	1.06	0.66	—	0.95	0.88	0.55	1.51	0.36	0.28	—	—	0.71
Soybeans																		
One hill between corn hills	0.49[1]	1.53	1.82	1.35	1.29	1.15	0.58	0.32	1.60	0.91	0.38	1.04	1.25	0.86	1.03	1.42	1.77	1.10
Two hills between corn hills	0.68	1.88	2.03	1.87	1.61	2.70	0.85	0.56	—	1.02	0.82	1.24	1.41	0.97	1.03	—	—	1.09
Velvet beans																		
One hill between corn hills	—	—	—	—	—	0.88	0.54	0.22	*	0.54	—	—	—	—	—	—	—	—
Two hills between corn hills	—	—	—	—	—	0.81	0.76	0.28	*	0.61	—	—	—	—	—	—	—	—
Mung beans																		
One hill between corn hills	0.50	0.46	0.34	—	0.43	0.18	0.05	0.04	—	0.09	0.70	0.35	0.55	—	0.79	0.65	0.33	0.56
Two hills between corn hills	0.62	0.52	0.66	—	0.60	0.32	0.04	0.06	0.72	0.28	0.99	0.32	0.43	—	0.87	—	—	0.63
Mung beans in wide middles	—	—	—	—	—	—	—	0.04	1.29	0.66	0.45	0.22	—	0.12	0.99	0.26	0.37	0.40
Cowpeas in wide middles	—	—	—	—	—	—	—	0.04	0.54	0.29	0.78	0.30	—	0.48	0.53	0.55	0.48	0.52
Soybeans in wide middles	—	—	—	—	—	—	—	0.04	1.13	0.58	0.40	0.09	—	0.24	0.93	0.48	0.13	0.37

*Discontinued in 1933.

[1] Harvested late, many leaves lost.

[2] Velvet beans grown in corn rows were harvested in 1932 when their yields of dry forage ranged from 1.80 to 2.24 tons per acre.

[3] In 1933 the planting plan was changed. Yields in 1933 and 1937 for legumes between corn hills are averages for 3 plots; for legumes in wide middles for two plots.

Reference: Arkansas Agricultural Experiment Station Bulletin 393, "Effects of Interplanting Legumes in Corn," pages 5, 6, 8, 9, 11, 12, 26 and 27, tables 1, 2, 3, 4, 5, 7, 18, 19 and 20, Fayetteville, Arkansas, June 1940.

Effect of Interplanted Legumes on Yields of Corn and Upon Cotton Grown in Rotation with Corn

Conducted by: Cotton Branch Experiment Station.

Conducted at: Marianna, Arkansas.

Period: 1926-1933.

Purpose: To determine the effect of interplanted legumes on yields of corn and upon yields of cotton grown in rotation with corn.

Table 97.—Effect of interplanted legumes on yields of corn and upon yields of cotton grown in rotation with corn—Arkansas, 1926-33.

Methods of planting the legumes in corn	No. of plots in final averages	Yield of corn in bushels per acre								
		1926	1927	1928	1929	1930	1931	1932	1933	Av.
A. Corn in 44" rows—no legumes	40	39.3	41.5	31.7	19.1	4.43	24.6	19.5	19.6	24.22
B. Corn in 44" rows—*Legumes in same rows (early)	64	24.3	33.5	27.5	15.7	3.96	17.9	19.7	22.4	20.62
C. Corn in 44" rows—legumes in middles (late)	61	38.0	36.8	29.5	22.6	5.24	23.7	19.6	21.5	24.62
D. Corn in 58" rows—legumes in middles (medium late)	27	30.2	20.2	25.6	25.9	3.40	25.8	14.2	19.3	20.58
Pounds of seed cotton per acre following corn with and without legumes as above explained										
A.	35	—	924	1016	935	352	1155	668	730	825
B.	56	—	1059	1177	1037	406	1321	904	1062	995
C.	56	—	881	958	913	317	1116	710	845	820
D.	21	—	921	858	846	422	1189	909	662	827

*Legumes used were cowpeas, soybeans, velvet beans, mungbeans—no velvet beans in 1933.

Reference: Arkansas Agricultural Experiment Station Data Sheet, 1933-38, February 23, 1934, Fayetteville, Arkansas.

Corn Interplanted With Legumes in Georgia

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Experiment, Georgia.

Period: 1934-1936.

Purpose: To determine the effect of summer legumes on corn.

Soil: Cecil sandy clay loam.

Procedure and Conditions: In this test 1/30-acre plots were used with six replications. Corn was spaced 18 inches in the drill and the rows were 3½-foot rows. The corn was planted in early May and no fertilizer was applied. These tests were conducted in a three year rotation, corn, small grains and summer legumes and cotton and winter legumes. The cotton received a complete fertilizer and the small grains were top-dressed.

Table 98.—Corn interplanted with legumes—Georgia, 1934-36.

Treatment	1934		1935		1936		3-yr. average	
	Air dry cut corn and leg. hay	Shelled corn per acre	Air dry cut corn and leg. hay	Shelled corn per acre	Air dry cut corn and leg. hay	Shelled corn per acre	Air dry cut corn and leg. hay	Shelled corn per acre
	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.
Corn alone (no legumes)	7,104	55.8	3,054	18.2	2,326	13.0	4,161	29.0
Corn and velvet beans								
Velvet beans planted when corn planted	7,092	30.8	4,738	7.9	2,553	12.4	4,794	16.9
Corn and velvet beans								
Velvet beans planted 3 weeks after corn	7,178	42.2	3,884	15.8	2,227	12.4	4,430	23.5
Average all corn and velvet bean plots	7,137	36.3	4,311	11.9	2,390	12.4	4,612	20.2
Corn and Otootan soybeans—corn	6,086	—	2,403	13.4	2,271	12.8	3,587	23.3
Soybeans planted when corn planted—beans	2,134	—	2,658	—	337	—	1,710	—
Total	8,220	—	5,061	—	2,608	—	5,296	—
Corn and Otootan soybeans—corn	6,176	—	3,001	—	2,442	—	3,873	—
Soybeans planted 3 weeks after corn—beans	1,497	48.2	408	17.6	36	13.8	647	26.5
Total	7,673	—	3,409	—	2,478	—	4,520	—
Average all corn	7,947	46.0	4,235	15.5	2,543	—	4,908	24.9

Reference: Georgia Agricultural Experiment Station Circular 126, "Corn Varieties, Hybrids and Cultural Practices," page 10, table 8, March 1941.

CORN CULTIVATION

Corn cultivation is important in that the labor required in cultivating falls during the labor peak in producing cotton. Each corn producer would like to make the highest yield of corn possible with as little labor as possible. Experimental information is presented in this section from several states.

Effect of Varying Number of Cultivations on the Yield of Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1921-1923.

Purpose: To determine the effect of number of cultivations on the yield of corn.

Soil: Sandy loam.

Procedure and Conditions:

Fertilizer: None used in any case.

Size of plots: The plots were six rows in width and 1/20-acre in size. The rows were 3½ feet apart and the hills were spaced 3 feet apart with 2 plants to the hill.

Number of replications: Four.

Each plot occupied approximately the same area each of the three years.

The early cultivations in the test were made with narrow shovel blades on a stock having three feet. The later cultivations were made with sweeps. All plots were thinned and hoed when the plants were three to six inches high. No other hoeing was done and weed growth was excessive on plots rceiving less than four cultivations.

Table 99.—Varying number of cultivations for corn—State College, 1921-23.

Number of cultivations	Total bushels per acre				Av. percentage nubbins
	1921	1922	1923	Average	
None	15.8	0.4	0.0	5.4	70.0
Two	34.9	28.8	20.0	27.9	14.2
Four	35.8	38.3	36.3	36.8	10.2
Six	38.6	39.8	35.7	38.0	10.0
Eight	39.6	37.7	36.6	38.0	9.5

Reference: Mississippi Agricultural Experiment Station Information Sheet 62, "Corn Cultivation," January 1935, State College, Mississippi.

Effect of Varying Depth of Cultivation on Yield of Corn

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1921-1923.

Purpose: To determine the effect of depth of cultivation on yield of corn.

Soil: Sandy loam.

Procedure and Conditions:

Fertilizer: None used in any case.

Size of plots: The plots were six rows wide and 1/20-acre in size. The rows were 3½ feet apart and the plants were spaced 3 feet apart with 2 plants to the hill.

Number of replications: Four.

Each plot occupied approximately the same area each of the three years.

All plots were thinned and hoed when the plants were three to six inches high. Cultivating plows were not used on plots scraped with hoe. The use of the spring tooth cultivator required more cultivations and more hoeing than did ordinary and deep shovel cultivation. Ordinary cultivation consisted of the use of narrow cultivating blades early and sweeps later. Deep shovel cultivation consisted of the use of new 8″ and 10″ shovels run deep at each cultivation. All cultivations were stopped shortly before the appearance of silks.

Table 100.—Effect of varying depth of cultivation on yield of corn—Mississippi, 1921-23.

Kind of cultivation	Total bushels per acre				Av. percentage nubbins
	1921	1922	1923	Average	
Scraping with hoe	35.6	44.8	39.5	43.3	10.9
Spring tooth cultivator	38.7	46.4	45.7	43.6	9.4
Ordinary cultivation	40.8	46.8	53.0	46.9	8.6
Deep shovel cultivation	40.9	46.0	48.2	45.0	8.8

Reference: Mississippi Agricultural Experiment Station Information Sheet 62, "Corn Cultivation," January 1935, State College, Mississippi.

Comparison of Different Methods of Cultivating Corn

Conducted by: Louisiana Agricultural Experiment Station.
Conducted at: Baton Rouge, Louisiana.
Period: Bench land: 1929-1936.
Alluvial land: 1934-1936.
Purpose: To compare different methods of cultivating corn.
Soil: Bench land: Olivier silt loam.
Alluvial land: Mostly Sharkey clay.

Procedure and conditions: In these tests different methods of cultivating corn are compared. Four row plots were used, each test being replicated four times. The two middle rows of each plot were harvested for experimental weights. The rows were 4 feet wide with corn spaced 28 inches apart in the drill. The corn was fertilized with 500 pounds 6-10-5 before planting. The experiment on the bench land was conducted in 1929 for five years on the same land. Plots were alternated on successive years. The 1934 bench land test was moved to another location. The same year tests were started on alluvial land which was conducted for three years.

Table 101.—Level versus ridge culture for corn—Louisiana, 1929-36.

	Bushels per acre							
Bench land*	1929	1930	1931	1932	1933	1935	1936	Average
Level cutlure	55.8	26.9	37.0	41.6	33.9	38.9	20.2	37.7
Ridge culture	61.9	32.6	42.7	43.6	35.9	43.8	17.4	38.7
Furrow culture	—	—	—	—	—	40.4	20.6	30.5
Alluvial land					1934	1935	1936	Average
Ridge culture					33.9	44.2	33.4	37.1
Level culture					30.7	36.9	29.7	32.4
Furrow culture					35.0	37.8	33.3	35.3

*In 1934 the corn was badly damaged by a tropical storm.

Reference: Louisiana Agricultural Experiment Station Bulletin 302, "Comparative Effects of Furrow, Level, and Ridge Culture on Corn Production at

Baton Rouge, Louisiana," pages 4, 5 and 6, tables 1, 2 and 3, November 1938, Baton Rouge, Louisiana.

Methods of Cultivation for Corn Compared

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Scott, Arkansas.

Period: 1925-1931.

Purpose: To determine the effect of cultivation on yield of corn.

Soil: Pulaski fine sandy loam.

Table 102.—Acre yield of corn-cultivation experiments—Scott Experimental Field—Arkansas, 1925-31.

Plot No.	Treatment	Bushels corn per acre							
		1925	1926	1927	1928	1929	1930	1931	7-yr. Av.
1.	Check, medium shallow until tasselled	27.6	51.1	29.3	30.0	8.8	5.2	29.4	25.9
2.	Very shallow until tasselled	19.3	51.1	30.1	32.5	8.6	7.0	30.9	25.6*
3.	Medium deep until tasselled	22.0	48.9	37.8	34.9	12 1	10.0	31.9	28.2
4.	Check, medium shallow until tasselled	21.2	53.4	43.1	34.9	9.4	9.4	39.4	30.1
5.	Deep cultivation until tasselled	26.9	52.2	46.1	36.7	10.2	10.8	51.6	33.5
6.	None, scraped with hoe	26.5	46.2	45.4	37.9	8.3	9.8	51.3	32.3
7.	Check, medium shallow until tasselled	32.1	49.1	52.7	34.2	9.6	9.9	56.9	34.9
8.	None, weeds undisturbed	.2	27.8	30.4	4.4	.7	7.6	24.4	13.6*
9.	Medium shallow until 2 feet high	28.7	54.6	51.8	32.8	14.5	9.3	46.3	34.0
10.	Check, medium shallow until tassalled	35.8	54.5	48.7	38.8	18.6	8.6	46.3	35.9
11.	Medium shallow until waist high	34.6	54.1	46.4	36.5	15.9	9.1	39.7	33.7
12.	Medium shallow until in roasting ear stage	38.1	57.4	43.5	36.5	19.9	7.4	37.2	34.3
13.	Check, medium shallow until tasselled	41.1	53.2	43.2	37.2	21.8	9.6	40.9	35.3
14.	Cultivations begun 4 weeks after planting	28.4	49.0	44.2	34.0	19.0	11.8	30.9	31.2
15.	Cultivation begun 6 weeks after planting	14.0	49.7	39.3	22.9	12.4	6.8	34.1	25.6*
16.	Check, medium shallow until tasselled	37.5	55.6	44.4	33.7	17.5	7.2	45.6	34.5
17.	Cultivation begun 8 weeks after planting	7.0	42.5	23.9	11.3	5.1	7.8	18.1	16.5
18.	Laid by deep when waist high	32.7	46.6	45.2	31.3	16.6	9.7	35.3	31.1
19.	Check, medium shallow until tasselled	29.1	47.5	37.5	28.3	13.4	9.3	35.9	28.7
20.	Laid by deep when tasselled	27.9	53.3	41.7	32.8	13.2	10.4	31.6	31.5
21.	Laid by deep when roasting ear stage	30.1	49.1	43.0	31.0	13.7	8.5	31.6	29.6
22.	Check, medium shallow until tasselled	27.4	51.4	41.3	31.7	14.9	10.5	34.1	32.0
Average of check		31.5	52.0	42.5	33.6	14.3	8.7	41.1	32.1

*Significant decrease in yields.

Reference: Arkansas Agricultural Experiment Station Bulletin 402, "Varietal and Cultural Experiments with Corn," page 27, table 13, June 1940, Fayetteville, Arkansas.

Laying-by Corn at Different Stages of Growth and Depth of Cultivation

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1925-1937.

Purpose: To determine the relative value of depth of cultivation at different stages of lay-by time.

Soil: Different soil types have been used for this work.

Procedure and Conditions: The methods of cultivation used in this experiment are as follows:

Medium cultivation: 3½ inches.

Very shallow cultivation: 1-inch.

Deep cultivation: 5 to 6 inches.

No cultivation but weeds scraped off with a hoe: Better determining the part that weeds play in questions surrounding cultivation and crop production.

Laying by at waist high: Considered early.

Cultivated very late: (roasting ear stage)—late.

Cultivation at medium depth changed to shallow later in the season: Was intended to find a more effective method than the usual one.

Cultivation delayed for 8 to 12 weeks with fertilizer added after 12 weeks: Were practices included in the experiment to determine for Arkansas conditions, the merits of the theory that checking the growth of the corn crop early and forcing growth thereafter lead to increased yields. (See table 103).

Corn Tillage in Jackson, Tennessee

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: West Tennessee Branch Experiment Station, Jackson, Tennessee.

Period: 3 years, 1911-1914.

Purpose: To compare different methods of cultivation.

Land History and Soil: The soils at the West Tennessee Experiment Station farm are silt loams such as are found over large areas in that part of the state. Two distinct types have been used in the experimental work. One may be described as a light, brown-colored silt loam with a yellowish-colored subsoil. This is naturally an excellent soil, easily handled and well adapted to a great variety of both farm and garden crops, but it has been greatly reduced in fertility by long continued cropping in cotton and corn. However, without manurial treatment, the yields of corn have run from 25 to 40 bushels per acre and of seed cotton from 700 to 1100 pounds. The other soil is a gray-colored "craw-fishy" type, with a gray subsoil. This soil is very light in silt, does not drain readily, and is troublesome to handle. The part used for experimental purposes had good surface drainage and had been in lespedeza, for which it is adapted, for a number of years, so that a fair supply of readily available nitrogen was present. Without manurial treatment the yields of corn have run from 28 to 37 bushels per acre and of seed cotton from 670 to 1030 pounds per acre.

The experimental fields were laid off in the spring of 1909 and a large part of the permanent rotation and fertility experiments were begun at that time. The period since then is too brief, however, for conclusive data on many of the projects undertaken and this publication is intended to present

Table 103.—Acre yield from corn-cultivation experiments—Arkansas Experiment Station, 1925-1937[1].

Plot	Treatment	Bushels per acre												
		1925	1926	1927	1928	1929	1930	1931	1932	1933	1935	1936	1937	12-yr. av.
1.	Check, medium shallow until tasselled	35.9	60.1	54.1	61.5	38.3	19.7	46.2	54.9	44.4	23.9	11.2	46.8	41.4
2.	Very shallow until tasselled	26.8	61.1	58.6	55.4	54.1	12.5	40.9	51.4	46.7	16.3	17.4	25.0	38.9
3.	Medium deep until tasselled	31.9	50.1	37.8	67.0	55.4	17.1	43.3	49.8	43.8	18.3	15.3	45.1	39.6
4.	Check, medium shallow until tasselled	34.7	56.6	63.7	75.6	41.3	20.5	45.8	63.9	42.0	17.1	18.4	49.2	44.1
5.	Deep cultivation until tasselled	32.0	44.6	59.1	71.5	28.8	17.7	44.7	68.5	35.7	15.0	18.6	45.0	40.1
6.	None, scraped with hose	27.4	55.3	68.2	57.1	27.8	17.3	34.7	65.6	29.3	15.5	14.7	31.4	37.0
7.	Check, medium shallow until tasselled	34.7	51.9	63.0	70.5	38.8	17.1	38.5	53.2	42.8	18.0	10.1	43.9	40.2
8.	None, weeds undisturbed	7.7	57.5	12.2	16.8	.9	.6	9.3	13.4	8.1	—	.0	15.6	11.8*
9.	Medium shallow until 2 feet high	30.0	49.8	56.7	50.0	33.6	15.3	33.7	24.5	40.6	9.8	16.7	28.1	32.4*
10.	Check, medium shallow until tasselled	29.3	47.2	65.7	64.7	42.1	14.2	42.6	68.7	40.1	12.4	21.4	43.9	41.0
11.	Medium shallow until waist high	32.8	53.2	61.6	62.3	37.0	16.9	41.0	63.7	42.0	12.2	23.9	41.7	40.8
12.	Medium shallow until roasting ear stage	33.2	54.0	67.9	66.2	40.4	17.1	42.0	57.1	43.2	17.1	13.9	43.5	41.3
13.	Check, medium shallow until tasselled	38.0	53.2	66.4	67.9	28.3	22.3	37.2	49.0	44.3	11.9	14.7	45.8	39.9
14.	Cultivation begun 4 weeks after planting	31.9	56.3	66.4	80.7	32.9	35.9	44.6	49.2	45.3	10.2	16.1	47.1	43.1
15.	Cultivation begun 6 weeks after planting	30.3	56.6	69.8	62.0	32.4	23.5	42.4	61.2	39.7	7.4	16.3	43.2	40.4
16.	Check, medium shallow until tasselled	32.5	54.3	59.8	65.1	40.6	12.7	41.2	60.9	41.7	11.1	21.3	41.0	40.2
17.	Cultivation begun 8 weeks after planting	21.3	29.5	44.8	40.6	37.9	11.1	26.5	44.1	15.2	6.9	9.3	26.8	26.2*
18.	Laid by when waist high	34.8	42.8	57.3	65.2	51.6	14.8	44.8	56.1	42.5	16.9	15.4	41.6	40.3
19.	Check, medium shallow until tasselled	33.7	48.8	61.2	66.5	42.3	16.2	40.6	53.2	44.5	13.2	23.3	41.1	40.4
20.	Laid by when tasselled	27.4	45.1	65.4	70.1	33.4	16.0	38.5	56.7	41.9	12.1	20.6	37.9	38.8
21.	Laid by deep when in roasting ear stage	30.6	54.3	60.4	59.3	27.5	15.0	36.1	52.8	41.1	13.0	19.0	39.9	37.4
22.	Check, medium shallow until tasselled	28.3	53.3	61.8	61.2	29.8	14.2	41.7	56.1	43.6	13.3	21.0	40.6	38.7
Average of checks		33.4	53.2	62.0	66.6	37.7	17.1	41.7	57.5	42.9	15.1	17.7	44.0	40.7

[1] No results in 1934 due to drought.

*Significant decreases in yields.

Reference: Arkansas Agricultural Experiment Station Forty-fifth Annual Report, Bulletin 297, "Summary of Research, 1887-1933," April 1934. Letter from C. K. McClelland, Assistant Agronomist, Arkansas Agricultural Experiment Station, Fayetteville, Arkansas. Arkansas Agricultural Experiment Station Bulletin 402, "Varietal and Cultural Experiments with Corn," page 26, table 12, June 1940, Fayetteville, Arkansas.

only the most important of the practical results available at this time (January, 1914).

Procedure and Conditions: Experiments in methods of tillage of corn were conducted for three seasons. Each year four methods were compared as follows:

Method 1—No cultivation, but weeds scraped off with hoe.

Method 2—Shallow cultivation, 12-tooth cultivator used throughout the season.

Method 3—Deep cultivation, double-shovel used according to common custom.

Method 4—First cultivation deep, with double-shovel, but after cultivation shallow.

Table 104.—Corn tillage experiments—Tennessee, 1911-14.

Experiment No.	Method of cultivation	Yield of grain per acre bushels
1	No cultivation, but weeds scraped off with hoe	37.7
2	Shallow cultivation, 12-tooth cultivator used throughout season	40.7
3	Deep cultivation, double-shovel used throughout season	38.9
4	First cultivation deep, but after cultivation shallow	42.7

Reference: Tennessee Agricultural Experiment Station Bulletin 109, "Fertility and Crop Experiments at the West Tennessee Station," pages 215 and 234, September 1914, Knoxville, Tennessee.

Method of Culture for Corn in South Carolina

Conducted by: South Carolina Agricultural Pee Dee Experiment Station.
Conducted at: Florence, South Carolina.
Period: 1915-1929.
Purpose: To determine the best method of fertilizing and cultivating corn.
Soil: Typical of large areas of the Coastal Plain section.

Table 105.—Methods of corn culture—South Carolina, 1915-29.

Method of culture	Average yields per acre
1. Level P & K applied at time of planting, nitrogen later	47.1 bu.
2. Level. Complete fertilizer applied at time of planting	50.4 bu.
3. Bedded up. P & K applied at time of planting, nitrogen latter	48.4 bu.
4. Bedded up. Complete fertilizer at time of planting	51.9 bu.
5. Williamson plan.* All fertilizer late	52.1 bu.

P—Potassium. K—Potash.

*The Williamson plan of cultivation is as follows:

1. Dwarfing the corn plant by withholding fertilizers until the plant is several feet high and by omitting all cultvation from time the plant is about eight inches high until it is about 18 inches high.
2. Thick planting in the row, which is made possible by the small size of plants.
3. Use of the turn plow in the last cultivations.
4. Planting on land enriched by plowing under the entire growth of cowpeas.

References: South Carolina Agricultural Experiment Station 42nd Annual Report, page 99, December 1929, Clemson College, South Carolina.

Alabama Agricultural Experiment Station Bulletin 138, "Variety Test with Cotton and Corn, Williamson Method of Corn Culture," page 102, December 1906, Auburn, Alabama.

Effect of Cultivation on Yield of Corn

Conducted by: Virginia Agricultural Experiment Station.

Conducted at: Blacksburg, Virginia.

Period: 1913-1916.

Purpose: To obtain the relative value of cultivation for corn.

Soil: Land of average fertility.

Procedure and Conditions: For this work two, one-half acre ranges were selected each year and divided into four plots each. The land was plowed to a depth of about eight inches during March and was disked and harrowed until a good seedbed was formed. Boone County White corn was used each year for the experiment and was planted about May 15, with an ordinary two-row corn planter. Up to the time for the first cultivation, each plot received exactly the same treatment. The treatment for the remainder of the season was as follows in every case except where changes are noted:

Plot 1 received no cultivation.

Plot 2 received no cultivation, but as often as weeds appeared they were scraped off with hoe, care being taken to disturb the soil as little as possible.

Plot 3 was cultivated 3 times with an ordinary corn cultivator to the depth of 2 to 3 inches.

Plot 4 was cultivated 5 times. The cultivation on plots 3 and 4 was as near similar to that given in ordinary corn fields as it was possible to give. An attempt being made to keep a soil mulch on the field.

These cultivations did not come at regular intervals, but were given when conditions indicated that they were needed. The first three cultivations on plot 4 were given at the same time as those on plot 3. The only difference between the two plots was that cultivation was kept up on plot 4 until five cultivations had been given.

The rainfall for the years the experiment was run is:

1913	21.25 inches	1915	20.59 inches
1914	17.62 inches	1916	27.23 inches

Table 106—Effect of cultivation on yield of corn—Virginia, 1913-16.

Method of cultivation	Bushels of grain				
	1913	1914	1915	1916	Average
No cultivation, weeds allowed to grow	7.49	No test	2.84	14.18	8.17
No cultivation, weeds cut with hoe	27.81	64.50	38.26	65.59	49.04
Three cultivations	34.99	75.70	51.51	75.53	59.43
Five cultivations	40.56	73.10	53.56	67.50	58.68

Reference: Virginia Agricultural Experiment Station Bulletin 214, "Corn Culture," pages 4, 8 and 9, March 1917, Blacksburg, Virginia.

Corn Cultivation

Conducted by: Illinois Agricultural Experiment Station.

Conducted at: Urbana, Illinois.

Purpose: To study the effect upon corn yield of weeds growing unmolested, of surface scraping to eradicate weeds without the formation of a mulch, and of shallow cultivation with blade or shovel cultivation.

Soil: Brown silt loam.

Procedure and Conditions: These studies were made on both fertilized and unfertilized plots arranged in 4 series of 6 plots each. The individual plots were 1/36 of an acre in size.

A four year rotation of corn, oats and sweet clover was practiced with soybeans used as a substitute crop when the clover failed in 1916, 1917 and 1919. All corn stalks and residues were removed from those plots which received no treatments of manure, rock phosphate or lime stone. All corn plots were disked, plowed, prepared and planted in the same manner.

When the plots were cultivated with blades the depth of cultivation was from 1 to 1½ inches, where shovels were used the average depth of cultivation was 2 to 3 inches. Plots 1, 3 and 5 served as checks and received no residues, manure, phosphate or limestone. Plots 2, 4 and 6 received manure in proportion to the crops produced, also one ton of rock phosphate and 2 tons of limestone per acre once in a rotation. Manure was applied to plots 2, 4 and 6 equal to the weight of all corn (grain), oats (grain and straw) and clover (hay and seed) removed from each plot. The manure was applied in the spring preceding the second year of corn. The phosphate and limestone was applied in the fall or early winter previous to the 1916 and 1920 crops. The results of these tests are given in tables 107 and 108.

Cultivation of Corn in Nebraska

Conducted by: Nebraska Agricultural Experiment Station.

Conducted at: Lincoln, Nebraska.

Period: 1922-1932.

Purpose: To compare the yield of corn under various cultivation practices.

Procedure and Conditions: The 11-year test was designed to develop the principles of cultivation. These tests, which were surface-planted at the rate of 3 plants per hill, may be described as follows:

1. No cultivation. The plats were left untouched after planting and weeds were allowed to grow.
2. Normal cultivation. This consisted of ordinary cultivation with a standard six-shovel cultivator, approximating 5 inches deep and 9 inches from the plants. This kind of cultivation was performed 1, 2, 3, and 4, times respectively, in different plats as indicated in the table.
3. Continued late cultivation. This involved four normal cultivations followed by one or two additional cultivations with a one-horse cultivator.
4. Scraped. The plats were not cultivated but the surface of the ground was merely scraped with a garden hoe at necessary intervals to control weeds.
5. Surface cultivation. Given four times with a cultivator having flat, blade-type shovels.
6. Shallow cultivation. (Four inches deep 9 inches from the plants.)
7. Deep cultivation. (Six inches deep 9 inches from the plants.)
8. Close cultivation. (Five inches deep 7 inches from the plants.)
9. Two harrowings followed by two cultivatins. (See table 109).

Table 107.—Cultivation experiments with corn on fertilized and unfertilized brown silt loam at Urbana, Illinois, 1916-21.

Plot No.	Treatment		Bushels per acre as an average of two plots								
			1916	1917	1918	1919	1920	1921	6-yr. av.	Av. percent of shovel-cultivated plots	
										Unfert.	fert.
1	Weeds allowed to grow	Unfertilized	.05	13.1	1.9	2.9	9.6	14.5	7.0	13.7	—
2	Weeds allowed to grow	Fertilized	.15	25.3	4.8	4.0	13.7	21.8	11.6	—	19.5
3	Scraped with hoe	Unfertilized	28.6	66.1	59.7	56.0	56.4	53.1	53.3	104.3	—
4	Scraped with hoe	Fertilized	29.8	65.3	62.4	61.6	61.4	53.5	55.6	—	93.4
5N	Cultivated—blades	Unfertilized	32.0	60.7	56.2	61.2	51.4	56.4	53.0	103.7	—
5S	Cultivated—shovels	Unfertilized	32.0	59.6	55.1	55.5	50.2	53.4	51.1	100.0	—
6N	Cultivated—blades	Fertilized	33.4	64.1	64.7	61.4	60.0	64.9	58.1	—	97.6
6S	Cultivated—shovels	Fertilized	36.5	67.5	62.1	57.0	67.9	65.8	59.5	—	100.0

Table 108.—Results of cultivation of first- and second-year corn on fertilizer and unfertilized brown silt loam at Urbana, 1916-21.

Plot No.	Treatment			Bushels per acre							
				1916	1917	1918	1919	1920	1921	Averages	
1	Weeds allowed to grow	Unfertilized	1st-yr. corn	.1	13.2	3.1	4.1	9.1	10.7	6.7	—
			2d.-yr. corn	.0	12.9	.6	1.6	10.1	18.2	7.2	7.0
2	Weeds allowed to grow	Fertilized	1st-yr. corn	.3	26.4	8.6	4.3	17.4	23.2	13.4	—
			2d-yr. corn	.0	24.2	.9	3.6	10.0	20.4	9.7	11.6
3	Scrapped with hoe	Unfertilized	1st-yr. corn	35.7	65.3	61.8	60.9	56.4	60.3	56.7	—
			2d-yr. corn	21.4	66.9	57.6	51.1	56.4	45.8	49.9	53.3
4	Scrapped with hoe	Fertilized	1st-yr. corn	31.4	65.7	65.0	69.6	59.6	53.8	57.5	—
			2d-yr. corn	28.2	64.9	53.8	53.5	62.9	53.2	53.7	55.6
5N	Cultivated—blades	Unfertilized	1st-yr. corn	36.4	64.3	65.8	68.6	51.9	65.7	58.8	—
			2d-yr. corn	27.6	57.0	46.0	53.7	50.8	47.1	47.1	53.0
5S	Cultivated—shovels	Unfertilized	1st-yr. corn	42.9	66.2	56.4	63.3	49.2	65.7	57.3	—
			2d-yr. corn	22.3	52.9	53.7	47.6	51.2	41.0	44.8	51.1
6N	Cultivated—blades	Fertilized	1st-yr. corn	40.6	68.1	66.1	67.2	70.4	73.4	64.3	—
			2d-yr. corn	26.1	60.1	63.3	55.6	49.6	56.4	51.8	58.1
6S	Cultivated—shovels	Fertilized	1st-yr. corn	45.3	68.1	61.5	61.4	71.4	72.1	63.3	—
			2d-yr. corn	27.7	66.8	62.6	52.6	64.4	59.5	55.6	59.5

Reference: Illinois Agricultural Experiment Station Bulletin 259, "The Cultivation of Corn," pages 192, 193 and 194, tables 9 and 10, March 1925, Urbana, Illinois.

Table 109.—The relation of manner and frequency of cultivation to the yield of corn—Nebraska, 1922-32.

Manner and frequency of cultivation	Yield of shelled corn per acre											
	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	Av.
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
None	11.4	6.5	4.5	3.9	0.0	16.4	—	—	—	—	—	7.11
1 normal	31.2	29.4	14.6	12.5	0.0	41.7	—	—	—	—	—	21.56
2 normal	44.0	42.5	24.3	37.2	0.0	53.8	22.0	52.2	9.5	14.4	47.1	31.54
3 normal	44.3	46.3	26.3	41.2	0.0	57.4	22.0	50.7	9.2	19.9	48.2	33.22
4 normal	45.0	50.3	28.0	40.3	0.0	59.4	23.6	48.6	10.5	19.9	48.6	34.01
4 normal and continued late*	43.3	46.1	24.6	40.4	0.0	57.0	24.1	50.2	9.2	21.4	50.6	33.35
Scraped	42.3	50.0	25.2	33.0	0.0	59.8	12.2	51.9	7.6	17.9	27.1	29.73
4 surface	—	—	—	—	0.0	—	—	51.4	9.6	19.4	41.6	30.50
4 shallow	40.0	50.1	24.6	39.5	0.0	60.6	18.2	52.6	9.7	19.1	47.0	32.85
4 deep	49.0	49.5	29.2	39.7	0.0	61.0	26.0	47.7	13.1	20.2	51.8	35.15
4 close	41.5	49.4	30.4	37.1	0.0	58.8	25.3	56.8	12.2	22.3	45.5	34.48
2 harrowings and 2 normal	—	—	—	—	—	—	26.6	57.2	11.3	20.3	35.6	30.20

*Four normal cultivations followed by one or two additional cultivations with a one-horse cultivator.

Reference: Nebraska Agricultural Experiment Station Bulletin 293, "Cultural Practices in Corn Production," pages 14 and 15, table 7, January 1935, Lincoln, Nebraska.

Part III

Oat Production

The acreage of oats in Mississippi has been steadily increasing the past few years. With additional interest being developed in the production of oats the demand for information on different practices dealing with oat production has also increased.

Experiments have been conducted on the various practices concerned with oat production in Mississippi and most other states; and the most appropriate of the published results are included in this section.

To successfully produce a crop of oats there are a number of production practices that should be considered. An attempt is made to present helpful experimental and other information appliable to Mississippi conditions in this publication on (1) oat varieties, (2) methods of land preparation, (3) dates and rate of seeding, (4) fertilizing oats, (5) harvesting, and (6) oat smut control.

OAT VARIETIES

Varieties of oats are very important in planning an oat production program. This is of increased importance now that a large part of our oats are harvested with combines. In using combines for harvesting it is necessary for the oats to become thoroughly ripened before harvesting, which means that the period over which a crop of oats can be harvested is relatively short. Combines cost a considerable amount of money and should be used to harvest as large an acreage as possible during a season in order to cut the cost of operation. It therefore seems desirable that varieties of oats be selected that ripen at different dates in order that the harvesting period may be extended by allowing a combine to take care of a much larger acreage. It may be economical to select oat varieties that ripen at different dates, provided there is not too great a sacrifice in the yield.

To make a selection of oat varieties that ripen a different dates, the producer must be familiar with the ripening dates of the different varieties. Experiment stations have arrived at approximate ripening dates for different oat varieties. The different varieties are classified in table 110 according to approximate ripening dates. In planning an oat production program it is suggested that an oat producer should not plant more than 30 to 40 percent of his oat acreage in early varieties, due to the somewhat lower yield of the early varieties, and from 60 to 70 percent of oats ripening at midseason.

Table 110.—Classification of oat varieties according to ripening dates.

Early May 21 to 27	Midseason May 29	Late June 4
Fulghum	Red Rustproof strains	Fulwin
Fulgrains	New Nortex	Tennex
Victorgrain	Appler	
Fultex	Ferguson 922	
Stanton	Hastings	
	Terruf	

The following tests show the results on oat varieties at different experiment stations.

Oat Variety Tests at Branch Stations in Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Holly Springs Branch Experiment Station, Holly Springs, Mississippi.
Raymond Branch Experiment Station, Raymond, Miss.
Natchez Branch Experiment Station, Natchez, Miss.

Period: 1939-1941.

Purpose: To compare the different varieties of oats.

Soil: Holly Springs: Grenada silt loam.
Raymond: Olivier silt loam.
Natchez: Lintonia silt loam.

Procedure and Conditions: The results of the oat variety tests at Holly Springs, Raymond and Natchez are given beginning with 1931. All plots in this series of tests received approximately 200 pounds 20 percent superphosphate at planting time and top-dressed with approximately 125 pounds of nitrate of soda per acre.

Table 111.—Oat variety tests at Branch Experiment Stations in Mississippi, 1939-41.

	Bushels grain per acre											
	Holly Springs				Raymond				Natchez			
Variety	1939	1940	1941	Av.	1939	1940	1941	Av.	1939	1940	1941	Av
New Nortex	17.0	56.0	74.3	49.1	34.7	72.2	49.0	52.9	56.6	57.7	41.8	42.0
Hastings	16.4	58.4	75.5	50.1	37.5	69.7	47.7	51.6	52.0	53.2	40.7	48.6
Appler	17.1	51.9	77.8	48.9	37.8	75.0	45.0	52.6	54.3	52.2	41.2	49.3
Ferguson 922	17.4	54.5	72.6	48.1	31.9	69.1	48.5	49.8	53.8	51.4	41.7	48.9
Terruf	17.7	55.0	74.6	49.1	39.4	69.7	41.5	50.2	56.6	57.4	43.0	52.3
Victorgrain	—	56.1	76.5	44.2	—	53.6	52.9	53.2	—	52.5	29.4	40.9
Ful.xW.T. 18-3	12.4	57.7	81.1	50.4	25.6	35.9	43.9	35.1	12.2	51.8	31.0	31.6
Fulgrain 1	16.1	56.7	79.9	50.9	14.8	37.8	44.3	32.3	13.2*	44.0	26.3	27.8
Fulgrain 3	—	57.2	70.8	42.6	—	34.4	39.8	37.1	—	45.5	28.1	26.8
Fulgrain 2	12.5	57.8	47.0	13.6	35.1	35.1	47.3	32.0	18.9*	42.9	26.7	29.5
Fulghum	13.0	56.0	77.2	48.7	16.6	32.3	39.5	29.4	9.5*	42.2	28.3	26.6
Fulgrain	—	52.5	61.0	56.7	—	36.6	44.3	40.4	—	44.1	22.2	33.1
Hairy Culberson	—	53.0	66.7	59.8	—	44.3	24.7	34.5	—	36.4	26.3	31.3
Stanton	—	—	80.4	—	—	—	53.1	—	—	—	43.1	—
Tennex	—	—	77.8	—	—	—	32.2	—	—	—	27.3	—
Fultex	—	—	68.0	—	—	—	47.4	—	—	—	30.8	—
Fulwin	—	—	84.0	—	—	—	30.8	—	—	—	26.7	—

*Moderate to severe bird damage.

References: Mississippi Agricultural Experiment Station Information Sheet 214, "Small Grain Varieties, 1939 and 1940," August 1940, State College, Mississippi.

Mississippi Farm Research, August 1941, State College, Mississippi.

Oat Variety Test at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1939-1941.

Purpose: To compare the different varieties of oats.

Soil: Ocklocknee.

Procedure and Conditions: The results of this test are given beginning with 1939. This test has been running for a longer period but due to the introduction of new strains and varieties it was thought a better comparison might be secured by beginning with the 1939 crop. None of the plots in this series of tests received fertilizer.

Table 112.—Oat variety test—State College, Mississippi, 1939-41.

Variety	Bushels grain per acre						
	Fall planted				Spring planted		
	1939	1940	1941	Av.	1940	1941	Av.
New Nortex	83.9	51.8	40.1	58.6	50.6	27.0	38.9
Hastings	85.9	50.6	41.5	59.3	51.4	23.7	37.5
Ferguson 922	91.7	51.4	40.5	61.2	50.7	28.4	39.5
Appler	88.6	49.1	41.4	59.7	49.9	24.9	37.4
Ful. x W. T. 18-3	85.3	52.9	36.4	58.2	43.8	34.4	39.1
Fulgrain 4	—	56.8	32.7	44.7	50.2	27.6	38.9
Fulgrain 1	80.9	54.4	33.4	56.2	51.4	34.3	42.8
Fulgrain 3	—	51.0	36.2	29.0	51.0	33.7	42.3
Terruf	96.5	44.2	41.3	60.6	49.5	23.7	36.6
Fulghum	66.4	48.1	35.5	50.0	46.7	28.4	37.5
Fulgrain 2	87.2	46.1	34.0	55.7	49.5	33.4	41.4
Victorgrain	—	42.8	40.0	41.4	52.9	28.7	40.8
Hairy Culberson	—	40.0	27.5	33.7	26.4	14.5	20.4
Tennex	—	—	40.0	—	—	26.3	—
Stanton	—	—	38.5	—	—	20.5	—
Fulwin	—	—	38.4	—	—	21.9	—
Fultex	—	—	34.7	—	—	23.4	—

References: Mississippi Agricultural Experiment Station Information Sheet 214, "Small Grain Varieties, 1939 and 1940," August 1940, State College, Mississippi.

Mississippi Farm Research, August 1941, State College, Mississippi.

Oat Variety Tests at Tifton, Georgia

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1920-1933.

Purpose: To test the different oat varieties for yield of grain.

Soil: Tifton sandy loam.

Procedure and Conditions: Four hundred pounds superphosphate was applied at planting time, 100 pounds of nitrate of soda was applied as a top-dressing early in **February**.

The oats followed corn in a two-year rotation. It was planted November 1 at the rate of eight pecks per acre.

Table 113.—Oat variety test at Tifton, Georgia, 1922-33.

Variety	Yield in bushels per acre												
	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	14-yr. av
Hundred Bushel	31.1	27.3	50.0	36.2	42.4	30.9	54.6	41.4	62.7	68.0	20.9	39.1	43.6
Bancroft	27.6	12.3	49.2	38.1	36.1	26.0	57.6	35.7	61.7	76.2	18.9	33.2	40.5
Appler	24.1	22.4	43.7	32.4	37.1	25.8	50.7	32.6	53.3	79.7	22.3	24.6	40.1
Patterson	32.8	16.0	42.9	29.9	40.0	26.4	47.7	36.1	58.4	—	—	—	—
Coker's Appler	26.4	12.4	47.9	38.4	45.2	27.3	—	—	—	—	—	—	—
Texas Rust Proof	26.5	23.1	48.0	31.7	36.3	26.8	53.5	35.7	56.4	64.1	22.7	37.3	37.2
Fulghum	42.1	16.1	30.7	29.9	45.9	25.4	51.4	10.5	39.6	69.6	2.6	17.0	33.6
Kanota	—	12.6	17.9	25.5	47.1	25.7	51.4	11.6	—	62.1	1.2	10.8	—
Burt	24.1	7.5	38.6	19.1	32.4	19.8	44.6	9.0	22.6	61.0	6.8	4.5	—
Early Ripe	25.1	8.3	37.6	15.6	23.0	13.7	—	—	—	—	—	—	—

References: Agricultural Education, Volume 5. pages 159-160, September 1928, Agricultural Education Department, Clemson College, South Carolina.

Georgia Coastal Plain Agricultural Experiment Station Bulletin 24, page 31, table 17, "Fourteenth Annual Report," June 1934, Tifton Georgia.

Oat Varieties

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1929-1938.

Purpose: To test different varieties of oats

Procedure and Conditions: All varieties included in the test were fertilized with 400 pounds of superphosphate and 50 pounds of muriate of potash in the fall. A top dressing of 200 pounds of nitrate of soda per acre was applied about March 1.

Table 114.—Yields of oats in variety test, Alabama, 3-year and 10-year averages—Alabama, 1929-38.

Variety	Bushels of oats per acre	
	Three-year average 1936-1938	Ten-year average* 1929-1938
Red Rustproof	68.1	52.5
Fulghum	—	46.8**
Appler	68.9	52.4
Hastings 100 Bushel	63.1	—
Fulgrain	56.2	—
Coker 33-47	54.0	—
Coker 33-50	44.5	—

*All varieties were injured by rust in 1929 and by drought in 1930.
**9-year average.

Reference: Alabama Agricultural Experiment Station Circular 60, "Small Grain Crops in Alabama," page 8, table 5, August 1931, Auburn, Alabama, (Revised August 1938.)

LAND PREPARATION FOR OATS

There are a number of methods of land preparation that may be used in producing oats. Some of the methods of land preparation are much more expensive than others. The difference in cost is due to the increased amount of labor and equipment. In considering the cost of land preparation the question naturally arises as to which method of land preparation will give the higher yields per acre. Experimental information is presented in this section in an attempt to show comparison of different methods of land preparation for oats.

Effect of Different Methods and Dates of Seeding on Yields of Oats

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1928-1933.

Purpose: The purpose of this experiment was to determine whether planting should be delayed in the fall until the land could be plowed, or whether it should be done earlier, without plowing and to learn whether or not plowing would increase the yield enough to be profitable.

Table 115.—Effect of different methods and dates of seeding on yields of oats*—Alabama, 1928-33.

Plot	Method of seeding	Date of seeding	Six year average yield 1928-1933
			Bu. per acre
1	Land turned; seed sown and disked in	Oct. 15	40.7
2	Land not broken: seed sown and disked in	Oct. 15	36.6
3	Land not broken; seed drilled with one-horse drill	Oct. 15	34.3
4	Land turned; seed sown and disked in	Nov. 15	33.3
5	Land not broken; seed sown and disked in	Nov. 15	29.5
6	Land broken; seed drilled with one-horse drill	Nov. 15	26.0

*Each plot received 200 pounds of nitrate of soda per acre.

Reference: Alabama Agricultural Experiment Station Circular 60, "Small Grain Crops in Alabama," page 4, table 2, August 1931, Auburn, Alabama. (Revised August 1938.)

Influence of Different Methods of Seeding on Yield of Oats

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1921-1927.

Purpose: To study the effect of different methods of seeding oats on yields of grain.

Procedure and Conditions: Each plot received an average of 116 pounds of nitrate of soda per acre annually.

Table 116.—Influence of different methods of seeding on yield—Alabama, 1921-27.

Plot No.	Method of seeding	Six-year average yield 1921-1927*
		Bu. per acre
1	Land not plowed; seed disked in	40.5
2	Land not plowed; seed drilled with one-horse drill	40.2
3	Seed sown and plowed in with one-horse plow	47.6
4	Land broken with two-horse plow; seed sown and disked in	48.6
5	Land broken with two-horse plow; seed drilled with one-horse drill	47.5

*The crop of 1924 was killed by cold and was not included in the average. Each plot received an average of 116 pounds of nitrate of soda per acre annually.

Reference: Alabama Agricultural Experiment Station Circular 60, "Small Grain Crops in Alabama," page 3, table 1, August 1931, Auburn, Alabama.

Effect of Different Methods of Preparing the Land on Yields of Oats

Conducted by: Georgia State College of Agriculture.

Conducted at: Athens, Georgia.

Period: 1913-1918.

Purpose: To determine the effect of different methods of preparing land on yields of oats.

Soil: Cecil sandy and clay soils.

The Cecil soils are:

Gray to red granitic lands with red clay subsoils.

A. 0-8 inches—light brownish-gray sandy loams to brownish-red clay loam.

B. 8-40 inches—compact red clay.

C. 40 inches—light red rotten rock.

Procedure and Conditions: The plots were fertilized at the rate of 400 pounds of phosphate to the acre before planting, and the oats top-dressed with 100 pounds of nitrate of soda or 80 pounds of sulphate of ammonia to the acre March 1 to March 15.

The experiment was conducted on land on which corn was grown the summer previous to sowing oats. The corn was cut and shocked about September and one seed bed was prepared by double disking with a disk harrow and another by plowing and harrowing.

Red Rustproof seed were used. The seed sown in these tests each succeeding year were taken from pure early sown oats. Eight pecks of seed were used to the acre.

The seed were treated for smut with formaldehyde every few years.

Table 117.—The effect of different methods of preparing the land on yield of oats—Georgia, 1913-18.

Method of preparation	Yield per acre in bushels						Average yield per acre in bushels
	1913	1914	1915	1916	1917	1918	
Land plowed	40.5	62.2	37.9	50.7	0.0	15.7	34.5
Land disked	46.6	64.2	35.3	36.2	0.0	25.3	34.6

All oats were winter-killed at this station in 1917, but this year is included in the average.

Reference: Georgia State College of Agriculture Bulletin 355, "Fall Sown Oats for Georgia," page 15, November 1928, Georgia State College of Agriculture, Athens, Georgia.

DATES OF SEEDING OATS

The date of seeding is important in oat production in Mississippi. Many times dates of seeding are directly influenced by climatic and moisture conditions. Dates of seeding may have an effect on the ripening date which will affect the time of harvesting and may represent the difference between high yields and crop failure. The following information shows the results of experimental data on different dates of seeding.

Dates of Seeding Oats at Stoneville, Mississippi

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1940-1941.

Purpose: To compare different dates of seeding with two varieties of oats.

Soil: Sandy loam.

Procedure and conditions: At the end of 1939 the old dates-of-seeding oats test was discontinued and a new test set-up comparing two varieties. This test is conducted on a new section of the station, but removed from the original location. All plots received the same treatment.

Table 118.—Dates of seeding oats at Stoneville, Mississippi, 1940-41.

Date	Variety	Bushels per acre			Variety	Bushels per arce		
		1940	1941	Av.		1940	1941	Av.
Oct. 1	Fulgrain Str. 3	85.2	78.9	82.1	Red Rustproof	93.7	86.7	90.2
Oct. 15	Fulgrain Str. 3	81.8	57.8	69.8	Red Rustproof	106.1	58.3	82.2
Nov. 1	Fulgrain Str. 3	89.8	54.8	72.3	Red Rustproof	96.7	40.5	68.6
Nov. 15	Fulgrain Str. 3	63.6	52.2	57.9	Red Rustproof	25.7	46.1	35.9
Feb. 1	Fulgrain Str. 3	12.5	4.7	8.6	Red Rustproof	1.5	2.2	1.9
Mar. 1	Fulgrain Str. 3	10.5	1.5	6.0	Red Rustproof	2.8	3.8	3.3

Reference: Mississippi Agricultural Experiment Station Service Sheet 313, "Oats Variety Test, Rates and Dates of Seeding—1941," July 1941, State College, Mississippi.

Dates of Seeding Oats

Conducted at: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1931-1939.

Purpose: To determine the best average date for seeding oats to produce maximum yields.

Procedure and Conditions: Comparisons were made of yields from fall plantings begun on September 15 and continued in 15-day intervals until November 15 and from Spring planting begun on February 15 and continued until April 1.

Table 119.—Yields from various dates of seeding oats—Stoneville, 1931-39.

Seeding dates	Bushels per acre									
	1931	1932	1933	1934	1935	1936	1937	1938	1939	Average
	Ferguson 922									
October 15	71.6	37.4	79.5	56.2	33.8	51.1	72.2	82.8	87.7	63.6
September 15	81.6	40.3	34.2	60.7	26.1	48.1	55.3	66.3	85.0	55.3
October 1	80.9	41.2	59.1	56.1	29.4	44.5	64.4	67.3	85.4	58.7
November 1	76.4	47.4	80.3	60.7	22.5	24.1	64.2	79.5	78.9	59.3
November 15	85.2	41.9	65.0	70.6	8.6	24.1	64.1	57.9	82.1	55.5
February 15	62.1	0.0	4.7	24.7	0.0	23.2	6.9	12.8	11.1	16.2
March 1	67.5	0.0	0.2	21.8	0.0	24.0	2.0	9.1	11.3	15.1
March 15	48.6	0.0	0.6	15.4	0.0	10.6	1.3	0.0	10.2	9.6
April 1	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	2.7	0.3

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," page 8, table 5, September 1939, State College, Mississippi.

A Comparison of Fall and Spring Planting of Oats

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1896-1924.

Purpose: To compare fall and spring planting of oats.

Table 120.—Comparative yields from spring and fall planting of Oats*—Alabama, 1896-1924

Year	Fall	Spring	Year	Fall	Spring
	Bushels	Bushels		Bushels	Bushels
1896	21.5	13.0	1911	56.9	31.5
1897	21.7	13.8	1912	57.7	10.9
1898	18.2	6.4	1913	48.5	12.1
1899	23.8	14.1	1914	53.1	34.6
1903	27.2	13.7	1915	40.1	5.3
1904	15.9	13.3	1920	24.2	9.7
1905	26.9	32.0	1921	44.1	47.1
1906	53.8	15.0	1922	31.5	3.9
1908	34.5	7.0	1923	31.8	9.7
1909	36.2	13.8	1924	0.0**	18.0
1910	49.1	31.2	Av.	34.1	17.0

*Fall and spring plantings were fertilized with 100 pounds of nitrate of soda per acre.
**Killed by cold.

Reference: Alabama Agricultural Experiment Station Circular 60, "Small Grain Crops in Alabama," page 5, table 3, August 1931, Auburn, Alabama. (Revised August 1938.)

Winter Versus Spring Oats

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Fayetteville, Arkansas.

Period: 1920-1933.

Purpose: To determine effect of fall planting and spring planting on the yield of oats.

Procedure and Conditions: In the earlier years covered by the report, the oats were grown mostly in plots about 2/55 of an acre in area. In later years this size was reduced to 1/55 of an acre, but the number of replications was increased to four. Land for the fall crop was plowed by the middle of August except in one or two years when plowing was delayed because of excessively

Table 121.—Some comparisons of winter and spring oat yields—Arkansas, 1920-33.

Year	Average yields per acre of all varieties		Average yields per acre of 5 highest varieties		Average yields per acre of 5 lowest varieties	
	Winter	Spring	Winter	Spring	Winter	Spring
	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels
1920	16.7	25.3	27.4	36.0	7.4	16.1
1921	27.3	31.9	38.3	30.2	17.7	22.6
1922	46.3	36.9	59.2	48.8	34.3	18.8
1923	57.4	50.0	70.3	58.4	43.1	28.4
1924	26.6	14.1	78.8	19.9	39.7	10.1
1925	31.8	39.9	42.0	45.5	22.9	27.3
1926	55.0	25.0	72.8	31.7	42.4	20.9
1927	51.1	14.4	59.7	22.9	42.8	5.7
1928	0.0	39.7	0.0	45.8	0.0	30.1
1929	58.5	39.2	76.7	46.3	33.5	29.9
1930	68.3	59.8	83.4	70.1	49.5	38.1
1931	84.6	61.5	92.3	67.8	75.9	52.0
1932	24.2	10.1	30.0	14.4	17.8	6.0
1933	53.9	62.3	38.8	46.3	18.3	—
Av.	43.0	34.1	56.6	41.2	33.8	23.9

Reference: Arkansas Agricultural Experiment Station Bulletin 301, "Oat Variety and Production Studies," page 3, 14 and 15, table 9, May 1934, Fayetteville, Arkansas.

dry soil. In a few instances where oats followed soybeans, later plowing was also necessary. The land for the spring crop was prepared at different times, early or late, according to the variations in the winter conditions. Usually the plowing was done in late November or early December, but very often it was delayed until late January or even February. With average planting date about the middle of March, the land had some time to settle and form a compact seedbed before the oats were planted. The land was loosened befor planting by a thorough disking. The fall oats ground was always disked at intervals to destroy volunteer growth. The soil of the Main Experiment Station farm is somewhat silty and heavy, therefore, the use of disc harrow was important to obtain a perfect seedbed.

Every fifth plot was used as a check plot. The land on the present Main Station farm was first used for experimental work in 1920, and in that year there was considerable variation in the check plot yields.

Rates and Dates of Planting Oats

Conducted by: Arkansas Agricultural Experiment Station.

Conducted at: Rice Branch Experiment Station, Stuttgart, Arkansas.

Period: 1929-1933.

Purpose: To determine the best date and rate of planting oats to secure the highest yield of grain.

Procedure and Conditions: Tests of rates and dates of planting oats were conducted at the Rice Branch Experiment Station. The maturing season of 1929 was only fair and that for 1931 was much better, and exceptionally good yields were obtained. Crown rust and winter damage in 1932 and 1933 greatly reduced yields. A good fall development of the oat plant not only acted as a conserver of plant food and a better factor in the control of erosion, but provided a higher degree of hardiness and better insurance against winter killing. Early planting also contributed to good fall development.

Table 122.—Results from varying rates and dates of planting winter oats—Arkansas, 1929-33.

	Bushels per acre		
	6 pecks	9 pecks	12 pecks
1929 Early, September 26	17.2	25.2	19.8
Medium, October 10	20.0	22.2	26.9
1930 (Winter killed)			
1931 Early, September 23	79.0	64.9	65.5
Medium, October 10	69.0	74.0	71.3
Late, October 25	80.0	84.7	81.6
1932 Medium, October 6	19.7	16.9	15.3
Late, October 26	6.8	6.9	5.6
1933 Medium Early, September 29	12.2	11.1	11.6
Medium Late, October 17	7.3	8.8	9.4

Reference: Arkansas Agricultural Experiment Station Bulletin 301, "Oat Variety and Production Studies," page 15, table 10, May 1934, Fayetteville, Arkansas.

RATES OF SEEDING OATS

There seems to be considerable amount of confusion among oat producers as to the rate that should be used in order to secure the highest yield of oats. In actual practice there is a wide variation in the rates of seeding. Several experiments have been conducted on rates of seeding oats and the results of some of the experimental work is present in this section.

Rates of Seeding Oats at Stoneville, Mississippi

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1940-1941.

Purpose: To compare different rates of seeding with two varieties of oats.

Soil: Sandy loam.

Procedure and Conditions: At the end of 1939 the old rates of seeding oats test was discontinued and a new test set-up comparing two varieties. This test is conducted on a new section of the station, but removed from the original location. All plots received the same treatment.

Table 123.—Rates of seeding oats at Stoneville, Mississippi, 1940-41.

Rate	Variety	Bushels per acre			Variety	Bushels per acre		
		1940	1941	Av.		1940	1941	Av.
4 pks.	Fulgrain Str. 3	84.3	74.9	79.6	Red Rustproof	103.9	85.4	94.7
6 pks.	Fulgrain Str. 3	84.8	70.9	77.9	Red Rustproof	101.8	76.0	88.9
8 pks.	Fulgrain Str. 3	85.7	81.9	83.8	Red Rustproof	98.6	77.4	88.0
10 pks.	Fulgrain Str. 3	89.8	69.5	79.7	Red Rustproof	103.9	67.6	85.8
12 pks.	Fulgrain Str. 3	76.6	77.1	76.9	Red Rustproof	110.6	76.8	93.7
14 pks.	Fulgrain Str. 3	81.1	72.5	76.8	Red Rustproof	115.0	72.3	93.7

Reference: Mississippi Agricultural Experiment Station Service Sheet 313, "Oats Variety Test, Rates and Dates of Seeding 1941," July 1941, State College, Mississippi.

Rates of Seeding Oats

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1929-1939.

Purpose: To determine the best average rate of seeding oats to produce maximum yields.

Soil: Sharkey loam.

Procedure and Conditions: The seeding rates were replicated 4 to 8 times and all factors other than seeding rates were kept as nearly constant as possible. The designated amount of seed for each planting was weighed, placed in separate packages and broadcast by hand.

Table 124.—Yields from various rates of seeding oats—Stoneville, 1929-39.

Rate	Bushels per acre											
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	Av.
						Ferguson 922						
10 pecks	72.3	57.5	95.3	48.5	52.6	73.9	39.3	60.8	61.3	72.5	79.3	64.8
6 pecks	64.4	61.3	90.8	49.3	49.5	76.9	36.3	59.0	61.3	73.1	78.3	63.2
8 pecks	49.3	58.5	92.7	51.1	48.9	74.0	32.6	60.6	62.1	73.6	79.5	62.1
9 pecks	72.5	57.7	89.8	49.0	52.4	82.0	40.0	60.2	57.4	71.6	78.3	64.7
11 pecks	68.6	53.4	91.4	48.8	48.8	89.4	42.0	58.6	58.3	71.0	78.5	64.4
12 pecks	73.3	56.5	24.8	52.3	48.0	72.5	43.5	55.8	61.6	69.7	76.8	64.1
14 pecks	68.7	58.2	106.9	49.1	52.1	63.6	37.4	58.2	53.8	73.6	77.9	63.6

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," page 9, table 6, September 1939, State College, Mississippi.

The Effect of Different Rates of Seeding on Yields of Oats in Georgia

Conducted by: Georgia State College of Agriculture.

Conducted at: Athens, Georgia.

Period: 1916-1925.

Purpose: To determine the rate of seeding oats to secure highest yield of grain.

Soil: Cecil sand to clay loam soil.

Procedure and Conditions: The plots were fertilized at the rate of 400 pounds of superphosphate to the acre before planting, and the oats top-dressed with 100 pounds of nitrate of soda or 89 pounds of sulphate of ammonia to the acre March 1 to March 15.

The seed were a pure-line selection of varieties used since 1917. The seed were treated for smut with formaldehyde every few years.

The oats in these tests were grown in a rotation of corn, oats followed by cowpeas and cotton.

Table 125.—The effect of different rates of seeding on yields of oats—Georgia, 1916-25.

Varieties	Rate of seeding (Pks. per acre)	Yield per acre in bushels									
		1916	1918	1919	1920	1921	1922	1923	1924	1925	9-yr. av.
Red Rustproof	3	38.3	5.0	6.6	61.1	59.4	57.2	62.9	0.0	57.5	38.6
Red Rustproof	4	40.7	5.4	8.9	57.1	60.0	60.0	62.0	0.0	59.2	39.2
Red Rustproof	6	45.7	15.9	16.4	68.5	63.1	64.6	62.6	0.0	59.5	44.0
Red Rustproof	8	43.4	18.7	18.9	57.6	61.1	53.1	59.6	0.0	58.2	41.1
Red Rustproof	10	40.5	23.5	18.8	65.5	60.8	48.7	54.8	0.0	58.4	41.2
Fulghum	3	—	1.2	8.7	46.1	38.9	60.6	29.0	0.0	57.0	30.1
Fulghum	4	—	1.0	9.8	42.4	35.7	53.5	34.8	0.0	55.6	29.1
Fulghum	6	—	3.1	12.7	46.2	37.9	56.3	35.1	0.0	58.6	31.2
Fulghum	8	—	4.9	12.7	45.3	39.9	64.3	38.2	0.0	63.2	33.5
Fulghum	10	—	9.3	13.8	37.8	38.3	67.9	35.6	0.0	71.2	35.4

Reference: Agricultural Education, Vol. 4, page 6, table 7, August 1927, Agricultural Education Department, Clemson College, South Carolina.

FERTILIZING OATS

Satisfactory oat production in Mississippi depends largely on the use of fertilizer. In some cases satisfactory yields are obtained without the use of fertilizer but there may be a question as to the length of time that a satisfactory yield can be maintained even on the most fertile soil without the addition of fertilizer.

Nitrogen is the main plant food used in producing oats in Mississippi, usually applied as a top-dressing in the spring of the year. The methods of applying the nitrate fertilizers vary. Some farmers apply the fertilizer by hand while others use various kinds of mechanical distributors; often the fertilizer is distributed unevenly, leaving strips that are not fertilized. Uneven distribution of fertilizer may reduce the yield of oats considerably. To overcome uneven distribution it may be necessary to use stakes to determine the width of ground covered, or to make a double application, one applica-

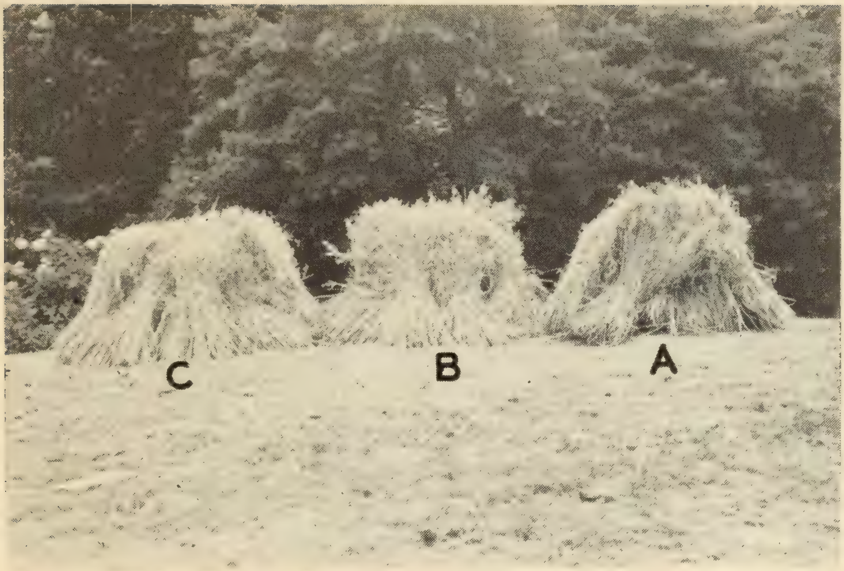

Figure 13.—Fertilizer treatment on oats at Main Station. State College, 1940. A, No fertilizer, 35 bushels per acre; B, 16 pounds nitrogen, 38 bushels per acre; C, 32 pounds nitrogen, 55 bushels per acre.

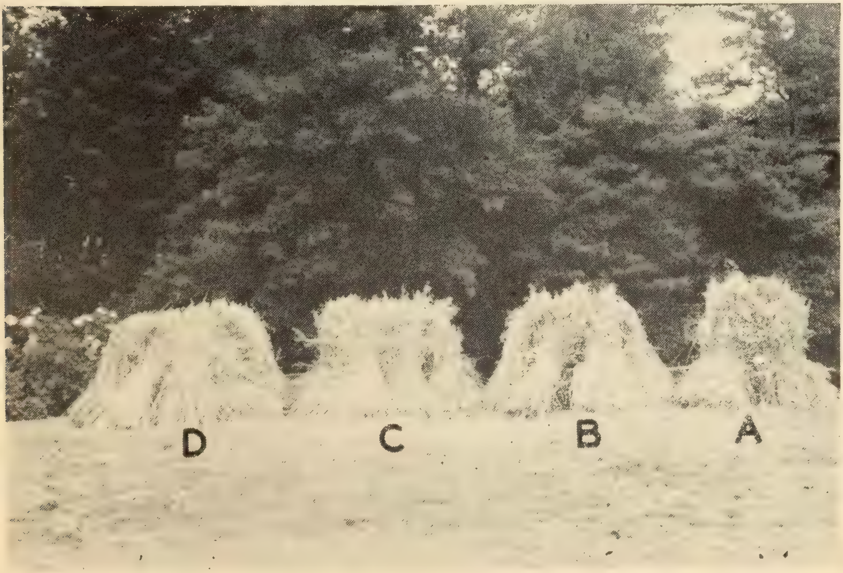

Figure 14.—Fertilizer treatment on oats at Delta Branch Station, 10-year average, 1932-41. A, No fertilizer, 21 bushels per acre; B, 15 pounds nitrogen, 43 bushels per acre; C, 30 pounds nitrogen, 55 bushels per acre; D, 45 pounds nitrogen, 61 bushels per acre.

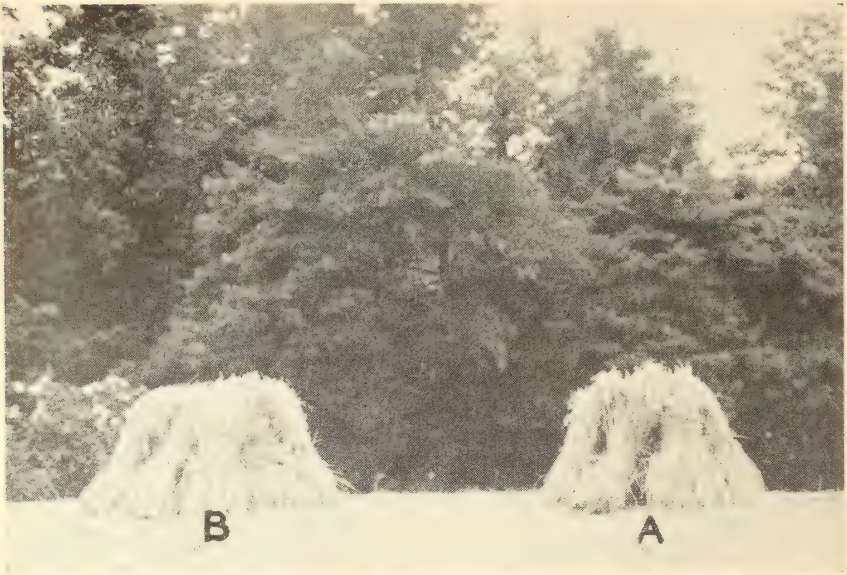

Figure 15.—Fertilizer treatment on oats in North Mississippi, 1940. These tests were conducted in Madison, Chickasaw, and Marshall counties. A, No fertilizer, 32 bushels per acre; B, 16 pounds nitrogen, 51 bushels per acre.

tion in one direction and the second application made across the first. Fertilizer distribution is an important matter in oat production and care should be exercised to see that the fertilizer is applied evenly.

Sources of Nitrogen for Oats

There has been some experimental work conducted on sources of nitrogen for oats. Nitrogen seems to be very important in any oat production program. In a large number of cases farmers in Mississippi are using only nitrogen carrying fertilizers for oats. The results of some experiments on nitrogen sources are presented in this section.

Sources of Nitrogen Test

Conducted by: Delta Branch Experiment Station.

Conducted at: Stoneville, Mississippi.

Period: 1932-1941.

Purpose: To determine the most economical source of nitrogen to use.

Soil: Sarpy loam.

Procedure and Conditions. This experiment was conducted in connection with a 3-year rotation using cotton, oats and corn. All plantings were fertilized in the same manner and oats were planted on the same plots every third year. Thirty pounds of nitrogen per acre was used from each source, which necessitated that the amount of fertilizer from each source vary in respect to its nitrogen content. Oats were seeded crosswise in all plots and fertilizer was weighed separately and applied by hand in the spring. Ferguson 922 and its strains were used every year except 1932 and 1933 when Norton was planted. All factors other than the source of nitrogen were kept as nearly constant as possible.

Table 126.—Yields of oats from various sources of nitrogen using 30 pounds nitrogen per acre—Mississippi, 1932-41.

Treatment	Bushels per acre										
	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	Av.
Unfertilized	0.6	13.9	11.7	22.7	15.1	27.2	21.1	24.8	48.5	13.5	19.9
Sodium nitrate	10.4	58.2	53.6	53.3	51.7	65.5	65.6	59.6	65.6	54.4	54.9
Ammonium nitrate	8.3	51.9	46.2	56.1	54.7	65.6	70.3	72.8	66.3	51.8	54.4
Ammonuim sulphate	6.1	39.8	40.6	50.7	55.4	62.0	65.3	72.8	62.8	54.2	50.9
Cyanamid	11.3	40.0	39.0	45.1	45.8	55.0	47.0	55.6	60.7	41.2	44.0
Cottonseed meal	3.5	20.0	21.3	37.0	34.0	45.9	39.0	41.5	55.7	28.5	32.6
½ C.S.M. & ½ S. nit.	7.2	34.4	38.4	46.2	44.3	52.1	47.1	55.9	55.4	41.8	42.2

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," pages 9 and 12, table 7, September 1939, State College, Mississippi.

New Sources of Nitrogen Test, Stoneville, Mississippi

Conducted by: Delta Branch Station.

Conducted at: Stoneville, Mississippi.

Period: 1928-1932.

Purpose: To compare some of the newer sources of nitrogen with the older sources.

Soil: Sharkey loam.

Procedure and Conditions: This experiment was conducted on a different field every year and treatments were replicated 5 to 8 times. The oats were seeded and fertilized as in the other sources of nitrogen experiment. Norton oats were used throughout this test.

Table 127.—Yields of oats from new sources of nitrogen applied at the rate of 30 pounds of nitrogen per acre on different land every year—Mississippi, 1928-32.

Treatment	Bushels per acre					
	1928	1929	1930	1931	1932	Average
Unfertilized	58.5	15.6	29.7	41.7	5.5	30.3
Sodium nitrate	61.0	36.5	50.1	86.5	8.9	48.6
Calcium nitrate	61.4	26.3	46.1	85.8	9.5	45.8
Ammonium sulphate	71.2	30.9	37.5	85.1	7.5	46.4
Cyanamid	60.5	20.5	38.4	73.3	7.9	40.1
Leunasalpeter	65.7	32.6	44.8	99.0	6.7	49.8
Calurea	60.4	31.5	47.4	80.8	6.8	45.4

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," page 13, table 8, September 1939, State College, Mississippi.

Sources of Nitrogen for Top-Dressing Oats

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1940.

Procedure and Conditions: The results shown below are an average of eight tests from eight different locations, six in the brown loam area and two in the prairie belt.

These tests were conducted using different sources of nitrogen, the amount of nitrogen being kept constant. Two rates, 16 and 32 pounds of nitrogen, were used per acre of the different sources of nitrogen. The nitrogen was applied about March 15.

Table 128.—**The effect of spring applied nitrogen on the yield of oats in the hill sections of Mississippi, 1940.**

Treatment	Yield in bushels per acre	Increase over no nitrogen in bushels per acre
No nitrogen	34.8	—
100 pounds of nitrate of soda (16 lbs. of nitrogen)	51.5	16.7
78 pounds of ammonium sulphate (16 lbs. of nitrogen)	46.9	12.1
72.7 pounds of cyanamid (16 lbs. of nitrogen)	44.4	9.6
200 pounds of nitrate of soda (32 lbs. of nitrogen)	59.4	24.6
156 pounds of ammonium sulphate (32 lbs. of nitrogen)	55.2	20.4
145.4 pounds of cyanamid (32 lbs. of nitrogen)	48.7	13.9

Reference: Mississippi Agricultural Experiment Station, Mississippi Farm Research, February 1941, State College, Mississippi.

Rates and Sources of Nitrogen for Oats

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Madison, Marshall and Chickasaw counties.

Period: 1940.

Purpose: To compare different rates and sources of nitrogen for top-dressing oats.

Soils: Olivier, Grenada and Waverly (Brown loam soils); Sumpter and Bell (Prairie soils).

Procedure and Conditions: In the spring of 1940 a series of tests was made with oats in the hill section of Mississippi including rates and sources of nitrogen applied as a top-dressing. Eight locations, 6 in the brown loam areas, and 2 in the prairie belt were used. These tests included the application of 16 and 32 pounds of nitrogen from nitrate of soda, cyanamid, and ammonium sulphate. Each test was replicated six times. All plots were fertilized on or near the 15th of March.

This test was conducted for one year only.

Table 129.—Rates and sources of nitrogen for oats, 8 locations in Mississippi, 1940.

	Bushels per acre						
	No nitrogen	16 lbs. nitrogen from nitrate of soda	16 lbs. nitrogen from cyanamid	16 lbs. nitrogen from ammonium sulphate	32 lbs. nitrogen from nitrate of soda	32 lbs. nitrogen from cyanamid	32 lbs. nitrogen from ammonium sulphate
Howard Green Canton, Mississippi	37.3	59.5	54.4	56.0	64.9	58.8	61.4
C. C. Lutz Grenada, Mississippi	32.2	51.2	41.0	49.1	59.5	53.5	60.4
Hugh Henderson Canton, Mississippi	49.4	65.0	61.0	63.6	71.7	65.6	70.5
H. H. Miller Farm Madison, Mississippi	35.4	62.3	42.6	50.7	68.8	52.8	67.8
Holly Springs Exp. Sta. Holly Springs (Hill)	30.6	40.0	34.0	38.2	49.3	35.8	39.0
Holly Springs Exp. Sta. Holly Springs (Valley)	31.4	50.8	51.7	42.8	66.4	40.6	49.2
Kahl Farm (Sumter clay) Egypt, Mississippi	23.6	32.9	27.3	28.0	39.1	32.4	34.9
Kahl Farm (Bell clay) Egypt, Mississippi	38.2	50.0	43.0	46.5	47.7	50.0	48.2
Weighted average of all tests	34.8	51.5	44.4	46.9	59.4	48.7	55.2

Reference: Mississippi Agricultural Experiment Station Bulletin 348, "Oats in Mississippi," pages 12, 14, and 15, table 11, September 1940, State College, Mississippi.

Source of Nitrogen for Oats

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: South Mississippi Branch Experiment Station, Poplarville, Mississippi.

Period: 1927-1930.

Soil: Ruston fine sandy loam.

Procedure and Conditions: Bayliss Red Rustproof oats was used in this test. Fertilizer was applied March 7, 1929 as a top-dressing.

Results in 1926 are as follows: 200 pounds nitrate of soda, 1830 pounds bundled oats; 150 pounds sulphate of ammonia, 1542 pounds bundled oats; 138 pounds calcium cyanamid, 1846 pounds bundled oats. The calcium cyanamid was applied at a slightly later date than the other fertilizers. The variety of oats threshed out 43 percent grain in 1926.

Table 130.—Fertilizer applied at the rate of 600 pounds per acre—Mississippi, 1927-30.

Formula N-P-K	Nitrogen source	Yield per acre			
		In pounds bundled oats		In bushels of grain	
		Oats planted in fall of			
		1927	1928	1929	1930
6-6-4	Nitrate of soda	4735	4766	49.1	34.2
6-6-4	Calcium nitrate	4645	4694	52.0	36.6
6-6-4	Calurea	4790	4749	47.8	35.5
6-6-4	Urea	4800	4629	46.6	38.4
6-6-4	Ammonium sulphate	4530	4158	—	—
0-6-4	None	3380	3337	26.4	21.8

References:

1. Press Circular 370, Mississippi Agricultural Experiment Station, June 1928.
2. Bulletin 238, page 5, Mississippi Agricultural Experiment Station, December 1926.
3. Bulletin 266, page 10, Mississippi Agricultural Experiment Station, December 1929.
4. Bulletin 274, page 24, Mississippi Agricultural Experiment Station, December 1929.
5. Bulletin 285, page 15, Mississippi Agricultural Experiment Station, December 1930.

Yield of Oats from Dates of Applying 30 Pounds of Nitrogen Per Acre Using Sodium Nitrate as the Source of Nitrogen, Stoneville

Conducted by: Delta Branch Station.

Conducted at: Stoneville, Mississippi.

Period: 1928-1936.

Purpose: To determine the time at which oats may most profitably be fertilized.

Soil: Sarpy loam.

Procedure and Conditions: This experiment was conducted in connection with a three-year rotation using cotton, oats and corn. Oats were seeded crosswise in all plots. Nitrogen was used at the rate of 30 pounds per acre and applied in separate plots at planting on three dates. Ferguson 922 and its strains were used every year except 1932 and 1933 when Norton was planted.

Table 131.—Yields of oats from dates of applying 30 pounds of nitrogen per acre—Mississippi, 1928-36.

Date of application	Bushels per acre								
	1928	1929	1930	1931	1932	1933	1934	1936	Av.
No nitrogen	30.5	25.3	29.3	45.7	0.7	20.3	9.5	14.3	22.9
November	46.2	60.7	60.0	100.3	3.8	59.5	41.8	53.3	53.2
March 15	57.2	59.7	62.7	101.8	8.2	44.6	51.7	59.2	55.6
April 1	64.6	65.8	62.2	70.4	4.5	40.5	50.7	49.9	51.0
April 15	60.2	64.1	63.8	94.3	2.0	28.2	21.1	47.6	47.7
½ November, ½ April 1	53.7	62.6	62.3	90.4	5.6	40.3	48.3	56.8	52.6
½ November, ½ April 15	66.8	61.9	59.1	89.3	3.7	29.7	35.6	49.3	49.4

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," page 15, table 10, September 1939, State College, Mississippi.

Date of Applying Fertilizer to Oats

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: South Mississippi Branch Experiment Station, Poplarville, Mississippi.

Period: 1927-1930.

Soil: Ruston fine sandy loam.

Procedure and Conditions: The plots in this test were 1/20-acre and replicated four times. Mayliss Rustproof oats were used.

Results had to be estimated in part in 1927 because of a 14.92 inch rainstorm which came just as the oats were being cut. Some plots were cut and shocked before the rain while others were cut several days after this protracted rain, which beat them down to the extent that they could not be cut clean. Portions of these plots were so damaged by this rain that they could not be cut at all and estimates were carefully made as to the portions of the plots actually cut and weighed.

The results for 1926 are as follows: 200 pounds nitrate of soda applied: February 15, 2468 pounds bundled oats; March 1, 2138 pounds bundled oats; March 15, 1776 pounds bundled oats. The oats threshed out 43 percent grain in 1926.

Table 132.—Date of applying fertilizer to oats—Mississippi, 1927-30.

Formula P-N-K	Yield per acre				Date of applying			
	Pounds bundled oats		Bushels of grain					
	1927	1928	1929	1930	1927	1928	1929	1930
0-6-0	3710	3157	33.5	22.2	Feb. 7	Feb. 7	Feb. 12	Feb. 12
0-6-0	3420	3270	35.4	21.5	Feb. 20	Feb. 20	Feb. 20	Feb. 25
0-6-0	3380	3464	18.8	21.3	Mar. 7	Mar. 7	Mar. 11	Mar. 11
6-6-0	3275	3564	42.1	35.4	Feb. 7	Feb. 7	Feb. 12	Feb. 12
6-6-0	3405	3070	41.5	30.8	Feb. 20	Feb. 20	Feb. 25	Feb. 25
6-6-0	3455	3236	37.7	31.7	Mar. 7	Mar. 7	Mar. 11	Mar. 11
None	1930	1783	16.6	12.9	Unfertilized			

Fertilizer applied at the rate of 600 pounds per acre.

References:

1. Press Circulars 298 and 373, Mississippi Agricultural Experiment Station.
2. Bulletin 238, page 5, Mississippi Agricultural Experiment Station, December 1926.
3. Bulletin 266, page 10, Mississippi Agricultural Experiment Station, December 1929.
4. Bulletin 285, page 18, Mississippi Agricultural Experiment Station, December 1930.
5. Bulletin 274, page 25, Mississippi Agricultural Experiment Station, December 1929.

Rates of Applying Nitrogen to Oats, Stoneville

Conducted by: Delta Branch Station.

Conducted at: Stoneville, Mississippi.

Period: 1928-1941.

Purpose: To determine the most economical rate of applying nitrogen to oats.

Soil: Sarpy loam.

Procedure and Conditions: The rates were varied in 7½-pound increments up to 45 pounds of nitrogen per acre, and sodium nitrate was the source of nitrogen used. This experiment was in the same rotation as the sources of nitrogen experiment and was conducted under similar conditions. The fertilizer was applied in the spring. Ferguson 922 variety and its strains were used every year except 1932 and 1933, when Norton was planted.

Table 133.—Yields from rates of applying nitrogen in 7½-pound increments to 45 pounds per acre, using sodium nitrate as the source—Mississippi, 1932-41.

Nitrogen rates	Bushels per acre										
	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	Av.
No nitrogen	1.0	16.3	9.2	26.2	14.9	24.6	22.3	26.1	47.9	18.1	20.6
7.5 pounds	4.1	27.1	18.5	37.8	26.1	35.2	39.0	39.3	49.3	29.2	30.5
15.0 pounds	5.6	41.9	31.3	53.1	39.9	60.0	51.7	50.0	52.9	43.1	42.9
22.5 pounds	9.3	44.6	34.2	44.1	48.9	63.2	60.3	60.4	57.9	52.0	47.4
30.0 pounds	7.6	57.9	51.0	54.3	63.0	71.5	61.7	69.8	61.4	55.1	55.3
37.5 pounds	5.0	61.6	57.0	57.4	64.0	74.3	64.8	73.5	63.8	54.4	57.5
45.0 pounds	9.6	70.3	72.2	59.2	68.8	63.3	71.9	75.0	67.2	53.0	61.0

Reference: Mississippi Agricultural Experiment Station Bulletin 334, "Small Grain Production in the Yazoo-Mississippi Delta," page 14, table 9, September 1939, State College, Mississippi.

Fall and Spring Applications of Sodium Nitrate, Ammonium Sulphate, and Cyanamid—30 Pounds Nitrogen Per Acre.

Conducted by: Delta Branch Station.

Conducted at: Stoneville, Mississippi.

Period: 1927-1939.

Purpose: To compare spring and fall applications of nitrogen to oats.

Procedure and Conditions: Three sources of nitrogen were used: sodium nitrate, ammonium sulphate, and cyanamid, and treatments were uniformly at the rate of 30 pounds nitrogen per acre. Fall applications were made in late November and spring applications were made in early March.

Table 134.—Yields of oats from fall and spring applications of Nitrogen—Mississippi, 1937-40

Treatment	Bushels per acre				
	1937	1938	1939	1940	Average
No nitrogen	18.1	21.7	6.2	49.2	23.8
Sodium nitrate—November	40.4	32.9	26.7	63.6	40.9
Ammonium sulphate—November	32.6	36.6	24.1	62.8	39.0
Cyanamid—November	32.0	35.1	19.7	59.6	36.6
Sodium nitrate—March	39.9	40.1	26.1	61.6	41.9
Ammonium sulphate—March	35.7	41.7	23.9	59.9	40.3
Cyanamid—March	39.3	38.0	20.8	61.2	39.8

Reference: Mississippi Agricultural Experiment Station Service Sheet 300, "Nitrogenous Fertilizers for Corn on Loam Soil," February 1941, State College, Mississippi.

Influence of Different Sources and Rates of Application of Nitrogen on Yield of Oats at Auburn, Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1927 to 1936 inclusive.

Purpose: To compare the sources and rate of application of nitrogen for oats.

Soil: Norfolk sandy loam.

Procedure and Conditions: The different sources of nitrogen were compared on the basis of 30 pounds of nitrogen (equivalent to 200 pounds of nitrate of soda) per acre.

Extremely heavy rains which occurred the day after the nitrogenous fertilizers were applied in 1929 caused heavy losses from leaching in this experiment. Nitrate of soda and calcium nitrate are more readily leached than the other sources of nitrogen and consequently, suffered a more serious loss.

The average yields in this experiment were reduced by rust in 1929 and by unusually dry weather in the spring of 1930. The yields were also smaller than they would have been on richer land; the area used is less productive than average Norfolk soil.

Table 135.—Influence of different sources and rates of application of nitrogen on yields of oats—Alabama, 1927-36.

Plot No.	Nitrogenous fertilizer* pounds per acre	Bushels of oats per acre	
		10-year average 1927-1936	Increase over average of check plots
1, 5, 9, and 13	None	9.5	—
2	100 nitrate of soda	19.7	10.2
3	200 nitrate of soda	32.2	22.7
4	300 nitrate of soda	41.5	32.0
6	400 nitrate of soda	45.7	36.2
7	500 nitrate of soda	46.9	37.4
8	150 ammonium sulphate	32.1	22.6
10	200 calcium nitrate	33.3	23.8
11	67.4 urea	32.8	23.3

*All plots received 400 pounds of superphosphate and 50 pounds of muriate of potash per acre.

Reference: Alabama Agricultural Experiment Station Circular 60, "Small Grain Crops in Alabama," pages 6 and 7, table 4, August 1931, Auburn, Alabama. (Revised August 1938).

Miscellaneous Fertilizer Treatments

A limited amount of information is presented on the effect of the use of nitrogen, phosphorus and potash on the yield of oats, also the effect of oats planted following legumes.

Effect of Nitrogen, Phosphorus and Potassium on the Yield of Oats

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Lowndes county.

Period: Fall sown oats—3 years.
Spring sown oats—2 years.

Purpose: To determine the effect of nitrogen, phosphorus and potassium on the yield of fall sown and spring sown oats.

Soils: Savannah, Kalmia, Ruston and Cahaba.

Procedure and Conditions: In 1935 a series of fertilizer analysis tests were begun on spring sown oats. The rate of fertilization was 400 pounds per acre of the different analysis. This test was continued two years and discontinued.

In 1937 a series of fertilizer analysis tests were started with fall sown oats on the same plots. These tests were fertilized as follows: 400 pounds 4-8-4, 400 pounds of 0-8-4 in the fall followed by a top-dressing in the spring with 16 pounds of nitrogen, 400 pounds of 4-8-0, 400 pounds of 4-0-4 and 1 plots unfertilized.

Table 136.—Effect of nitrogen, phosphorus and potassium on the yield of oats—Mississippi, 1935-37.

	Fall sown oats—3-yr. average					Spring sown oats—2-yr. average				
	400 pounds 4-8-4	400 pounds 0-8-4*	400 pounds 4-8-0	400 pounds 4-0-4	No fertilizer	400 pounds 4-8-4	400 pounds 0-8-4	400 pounds 4-8-0	400 pounds 4-0-4	No fertilizer
T. F. Richards Columbus, Miss.	26.1	31.3	27.7	19.3	11.0	—	—	—	—	—
D. E. Egger Caledonia, Miss.	18.7	23.2	20.9	11.6	9.0	20.6	10.9	20.6	19.7	11.5
S. E. Bryant Columbus, Miss.	32.7	34.3	31.2	25.0	22.3	19.6	9.3	18.9	16.1	8.8
H. G. Betts Caledonia, Miss.	18.1	20.1	16.1	13.4	8.3	23.1	11.1	18.3	19.6	9.0
Bob Egger Caledonia, Miss.	20.3	27.8	20.2	15.5	9.3	23.3	14.6	25.2	17.6	12.5
Weighted average of all tests	23.2	27.3	23.2	17.0	12.0	21.7	11.5	20.8	18.3	10.5

*Top-dressed March 15 with 16 pounds of nitrogen (100 pounds of nitrate of soda) per acre.

Reference: Mississippi Agricultural Experiment Station Bulletin 348, "Oats in Mississippi," pages 17 and 18, tables 12 and 13, September 1940, State College, Mississippi.

Yield of Oats Produced with Fertilizer of Different Analysis with Various Sources of Nitrogen and with Fertilizers Applied at Different Times

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Black Belt Substation, Marion Junction, Alabama.

Period: 1932-1936.

Purpose: To test the various sources of nitrogen, time of applying fertilizer, and different ratios.

Soil: Sumter clay.

Procedure and Conditions: Phosphate and potash were applied at planting, nitrogen applied in spring as top-dressing except as shown in table of results.

In Lot 8 the nitrogen was from Ammo-Phos as top-dressing, Ammo-Phos was applied at planting in Lot 9. All fertilizer was applied at planting in Lot 10.

Table 137.—Yield of oats produced with fertilizers of different analysis with various sources of nitrogen, and with fertilizers applied at different times on Sumter clay—Alabama, 1932-36,

Plot	Fertilizer treatment Basis 600 lbs. per acre	Source of nitrogen	Yield per acre bushels						Increase over no fertilizer
			1932	1933	1934	1935	1936	5-yr. av.	
1	0		21.4	6.9	28.6	10.8	38.0	21.1	—
2	0-10-4	Ammonium sulphate	25.9	19.9	37.6	21.1	61.4	33.2	12.1
3	3-10-4	Ammonium sulphate	38.0	23.6	45.9	24.3	71.3	40.6	19.5
4	6-10-4	Ammonium sulphate	44.3	30.1	51.7	27.6	74.1	45.6	24.5
5	6-10-0	Ammonium sulphate	51.1	24.5	52.6	29.1	77.0	46.9	25.8
6	6-0-4	Ammonium sulphate	29.5	18.4	31.1	25.0	47.1	30.2	9.1
7	6-10-4	Nitrate of soda	54.4	38.3	54.1	37.0	78.3	52.4	31.3
8	6-10-4	Ammo.-Phos.	35.7	24.7	52.3	29.6	68.2	42.1	21.0
9	6-10-4	Ammo.-Phos.	41.0	20.5	44.7	25.4	66.9	39.7	18.6
10	6-10-4	Ammonium sulphate	43.1	19.8	50.0	21.3	67.9	40.4	19.3

Reference: Alabama Agricultural Experiment Station Circular 78, "Fertilizer and Crop Experiments on Certain Soils of the Black Belt," pages 10 and 23, table 5, July 1937, Auburn, Alabama.

The Effect of Lespedeza, Crotalaria and Soybeans on Oat Production

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Raymond Branch Experiment Station, Raymond, Miss.

Period: 1939.

Procedure and Conditions: This test was started in the summer of 1939. Varying analysis of fertilizer were placed under the different legumes and all oat plots except the check series were top-dressed on March 15 with 24 pounds of nitrogen from nitrate of soda.

A strain of Red Rustproof oats were seeded in the fall. The soybeans and crotalaria were turned under prior to the oat seeding. The lespedeza was cut for hay and the land was not broken on the lespedeza plots before seeding to oats. The plots in this test were 1/40-acre plots, being replicated 4 times.

Table 138.—The effect of summer legumes and their fertilizer treatment on the yield of oats top-dressed with 24 pounds nitrogen—Mississippi, 1939.

Treatment	Yield of oats Bushels per acre
Oats continuously—not top-dressed	45.0
Oats following corn—oats top-dressed	68.0
Lespedeza unfertilized and cut for hay—oats not top-dressed	50.0
Lespedeza fertilized with 400 pounds 0-8-8 and cut for hay—oats top-dressed	69.0
Lespedeza fertilized with 400 pounds 0-8-0 and cut for hay—oats top-dressed	76.0
Lespedeza unfertilized and cut for hay—oats top-dressed	71.0
Crotalaria unfertilized and turned under—oats top-dressed	80.0
Crotalaria fertilized with 400 pounds 0-8-8 and turned under—oats top-dressed	81.0
Crotalaria fertilized with 400 pounds 0-8-0 and turned under—oats top-dressed	88.0
Tokio soybeans unfertilized and turned under—oats top-dressed	83.0
Tokio soybeans fertilized with 400 pounds 0-8-8 and turned under—oats top-dressed	83.0
Tokio soybeans fertilized with 400 pounds 0-8-0 and turned under—oats top-dressed	77.0

Reference: Mississippi Farm Research, September 1940.

HARVESTING OATS

In the past few years the methods of harvesting oats have changed in most cases from the use of binders and threshers to the use of combines. In certain sections of Mississippi still other farmers are investigating possibilities of using combines for harvesting grain crops and in many cases are having to make this investigation with a limited amount of information on which to base a decision.

Some studies have been made in Missouri and Indiana on the use of small combines for harvesting grain crops. It is realized that conditions in Missouri and Indiana may not always be directly applicable to Mississippi conditions but the results obtained in those states should be helpful after making certain adjustments in determining the life, cost of operation, and acreage of grain crops that a combine will handle under Mississippi conditions.

Harvesting Small Grains

A study of combines in Missouri.

Combine harvesters are becoming more and more popular every year in harvesting of grain crops. In 1937, 1938 and 1939 the University of Missouri made a study of 182 case farms on the use of combines and harvesting grains. Table 139 shows a summary of crops harvested by the 182 combines.

The capacity of combines is very important. The purchaser should have some very definite ideas or information about the number of acres a particular size combine will harvest before purchasing a machine. Table 140 shows the average acres cut per day and an estimated approximate acreage the different sizes of combines will harvest. Table 140 also shows the amount of crops harvested on the owners farm and in addition the custom work done.

The cost of combining is one of the first questions that should be considered in buying a combine. The average cost of harvesting along with other pertinent data for 182 combines included in this study is given in Table 141. The various items of cost for each individual case were calculated as follows:

I. Overhead Costs:
  1. Annual depreciation, first cost of the machine divided by the years of life, as estimated by the owner.
  2. Annual interest, 5 percent of average value, or half of purchase price.
  3. Annual taxes and insurance, 1 percent of average value, or half of purchase price.
  4. Annual housing cost, $3.00 for 40-inch sizes, $4.00 for other sizes.
  5. Annual repair cost, as reported by the owners.

II. Operating Costs:
  1. Fuel, oil, and grease as reported by the owners.
  2. Power costs, $2.00 per day for 1-plow tractors.
     $2.50 pre day for 2-plow tractors.
     $3.00 per day for 3-plow tractors.

III. Labor Costs:
  $2.00 per day for 1-man outfit; $5.00 per day for 2-man outfit.
  ($2.00 for tractor operator, and $3.00 for combine operator.)

This information should be helpful in determining the approximate cost of combine operation. The fact should be considered that in this study the high percentage of crops harvested was wheat while under Mississippi conditions the high percentage of crops will no doubt be oats and may have a direct bearing on the cost of combine operation.

Table 139.—Crops harvested in one year by the 182 combines surveyed.

Crops	Acres	Percent of total
Wheat	41,326	86.09
Oats	3,165	6.60
Barley	1,929	4.02
Timothy	480	1.00
Lespedeza	319	0.67
Sweet clover	265	0.55
Soybeans	240	0.50
Rye	118	0.25
Flax	52	0.11
Red Top	20	0.06
Sorgo	21	0.04
Kafir	20	0.04
Alsike clover	16	0.03
Alfalfa	10	0.02
Red clover	10	0.02
	48,001	100.00

Table 140.—Acres cut per day and per year by combine—Missouri, 1937-39.

Size of combine	No. of machines	Av. acres cut per day	Average amount		Average total acres cut per year	Estimated maximum acreage of wheat and oats to be cut per year
			Own work acres	Custom work acres		
40-in.	8	7.6	52	56	108	125
5-ft.	53	13.8	154	84	238	236
6-ft.	40	14.4	103	103	206	240
8-ft.	52	18.1	152	145	297	320
10-ft.	11	20.9	189	117	306	332
12-ft.	18	25.3	223	128	351	388

Table 141.—Results of survey of 182 combines—Missouri, 1937-39.

Size of machine	40-inch	5-foot	6-foot	8-foot	10-foot	12-foot
Number of machines	8	53	40	52	11	18
Average cost	$384.00	$650.00	$899.00	$1178.00	$1214.00	$1476.00
Owner's estimate of life						
Years	6.8	7.1	8.5	9.4	10.3	9.1
Acres	734	1690	1751	2792	3152	3194
Average years used	1	1.5	1.5	1.6	6.5	2.9
Estimated yearly capacity, wheat and oats, acres	125	236	240	320	332	388
Own crops harvested, acres in 1 year	52	154	103	152	189	223
Custom crops harvested						
Acres in 1 year	56	84	103	145	117	128
Percent of total	51.8	35.3	50.0	48.8	38.2	36.5
Total acres harvested in 1 year	108	238	206	297	306	351
Total days used in 1 year	14.1	17.3	14.5	16.3	14.7	14.5
Average acres cut per day	7.6	13.8	14.4	18.1	20.9	25.3
Average acres per day per foot of cutting width	2.3	2.8	2.4	2.3	2.1	2.1

	Average costs of combining											
	Per year	Per acre	Per year	Per acre	Per year	Per acre	Per year	Per acre	Per year	Per acre	Per year	Per acre
I. Average overhead costs												
1. Depreciation	$57.82	$0.69	$97.27	$0.47	$108.09	$0.58	$128.63	$0.50	$123.13	$0.46	$175.43	$0.59
2. Interest	9.60	0.09	16.26	0.08	22.48	0.12	29.45	0.11	30.35	0.10	36.90	0.11
3. Taxes and insurance	1.92	0.02	3.25	0.02	4.48	0.02	5.89	0.02	6.07	0.02	7.38	0.02
4. Repairs	2.16	0.02	9.81	0.04	10.95	0.05	10.14	0.03	15.81	0.05	19.28	0.05
5. Housing	3.00	0.03	4.00	0.02	4.00	0.02	4.00	0.01	4.00	0.01	4.00	0.01
Total overhead costs	74.50	0.85	130.54	0.63	150.00	0.79	178.11	0.67	178.44	0.64	242.90	0.78
II. Average operating costs												
1. Fuel	1.34	0.18	1.86	0.14	2.33	0.16	2.95	0.16	2.95	0.14	4.18	0.16
2. Oil and grease	.32	.04	.46	.04	.55	.05	.70	0.05	.79	.06	.93	.06
3. Tractor cost (other than fuel, oil and grease)	2.31	0.32	2.55	0.20	2.52	0.18	2.60	0.15	2.63	0.14	2.75	0.11
Total operating costs	3.97	0.54	4.87	0.38	5.40	0.39	6.25	0.36	6.37	0.34	7.86	0.33
III. Average labor costs, tractor and tractor and combine operator or operators	3.00	0.41	3.00	0.23	3.00	0.22	4.07	0.23	5.00	0.26	5.00	0.21
Total acre cost		$1.80		$1.24		$1.40		$1.26		$1.24		$1.32

Reference: Missouri Agricultural Experiment Station Bulletin 426, "Combine Harvesters in Missouri," pages 3, 4, 5, 8, and 9, tables 1, 2, 3, and 7, April 1941, Columbia, Missouri.

A Study of Harvesting With Small Combines in Indiana

From 1935 to 1937 the Department of Farm Management and Department of Agricultural Engineering at Purdue University made a study of harvesting with small combines in Indiana. Records were secured of farmer owned and operated combines. Eighteen records were secured in 1935, 51 records in 1936, and 61 in 1937.

The size of farms in this study that had combines varied from 80 acres to 800 acres. The average size farm was 289 acres.

The combines used in this study had cutter bars of either 5 or 6 feet in length; a large percentage were 5-foot machines. Table 142 shows the average acres in the various crops harvested each year.

Table 142.—Data on operation of combines surveyed in Indiana, 1935-37

Crops		Average acreage harvested			
		1935	1936	1937	Average
Wheat	own	59	32	39	43
	custom	37	31	51	40
Oats	own	14	30	18	21
	custom	8	17	15	13
Soybeans	own	61	35	27	41
	custom	84	81	66	77
Rye and barley	own	3	1	3	2
	custom	13	5	4	7
Clover, alsike, alfalfa, timothy, etc.	own	4	5	2	4
	custom	4	23	3	10
Total	own	141	103	89	111
	custom	146	157	139	147
Total		287	260	228	258
Number of combines		18	51	61	—
Annual overhead costs of operating small combines					
Items of cost					
Depreciation		$130.40	$ 97.02	$129.02	$118.81
Interest on investment		16.88	19.29	20.15	18.77
Taxes		4.49	4.89	5.77	5.04
Shelter		5.86	5.60	5.82	5.76
Insurance		.17	.19	.38	.25
Repairs		4.97	26.70	13.38	15.01
Oil and grease		2.08	1.76	2.06	1.96
Total		$164.85	$155.43	$176.58	$165.66
Total acres cut		287	260	228	258
Machine cost per acre		$ 0.58	$ 0.60	$ 0.78	$ 0.64
Number of records		18	51	61	—
Total acre costs of harvesting grain with the small combine					
Items of cost					
Indirect charges		$0.58	$0.60	$0.78	$0.65
Labor		.17	.19	.22	.19
Fuel		.12	.13	.15	.14
Motor oil		.01	.02	.01	.01
Tractor charge		.29	.30	.30	.30
Total		$1.17	$1.24	$1.46	$1.29
Acres cut (average)		287	230	228	258
Number of records		18	51	61	—

The cost of harvesting with a combine may be divided into overhead cost and operation costs. Table 142 shows the annual overhead cost of operating the small combines, and also shows the total per acre cost of harvesting grain.

In sections of Mississippi the binder-thresher method of harvesting grain is used. Table 143 shows a comparison of the cost of combine method of harvesting with the binder-thresher. Table 144 shows the average acres harvested per day.

The information presented in this study is taken from Indiana farms and may not be adaptable in every respect to Mississippi conditions, in that different crops are produced. The topography of the land no doubt is somewhat different but the information presented should serve as a guide in determining what may be expected from the use of combines in Mississippi.

Table 143.—The comparative acre costs of harvesting the various crops by the small combine and the binder-thresher method during 1935, 1936 and 1937.

Crop	Combine method				Binder thresher*
	1935	1936	1937	Average	
Wheat	$1.26	$1.37	$1.71	$1.45	$2.98
Oats	1.17	1.38	1.58	1.38	2.53
Soybeans	1.27	1.42	1.52	1.40	3.03
Rye and barley	1.16	1.19	1.66	1.34	2.40
Clover, alfalfa, timothy, alsike	1.10	1.29	1.24	1.21	2.67
All crops	1.17	1.24	1.46	1.29	2.87
Number of records	18	51	61	—	127

*1927-1928-1929 averages with 1935-1936-1937 prices substituted.

Table 144.—Average acreage harvested per day with the small combine.

Crop	1935	1936	1937	Average
	Acres	Acres	Acres	Acres
Wheat	13.2	11.2	11.2	11.9
Oats	14.0	10.8	10.4	11.7
Soybeans	11.6	10.0	10.4	10.7
Rye and barley	11.6	11.2	10.0	10.9
Clover, alsike, timothy and alfalfa	12.8	9.2	12.0	11.3
All crops	12.8	10.4	10.8	11.3

Reference: Indiana Agricultural Experiment Station Bulletin 436, "Economic Study of Harvesting with a Small Combine in Indiana," pages 5, 6, 7, 10, and 11, tables 1, 2, 3, 4, and 5, April 1939, Lafayette, Indiana.

OAT SMUT CONTROL

Smut is one of the most serious diseases of oats found in Mississippi and in many cases yields of oat are seriously reduced by smut. It is felt that each oat producer should try to control oat smut. Information is presented in this section on methods of treatments that have been used in controlling oat smut.

Appearance*

As the infected oat head emerges from the sheath, it presents a brownish-black mass of powder which has replaced the chaff and grain of each spikelet. The smut masses of each spikelet may be surrounded by a delicate white membrane but this soon breaks and liberates the black smutty powder, each grain of which is a fungus spore. Diseased plants can not be distinguished from healthy plants before heading, and diseased plants will often be over-

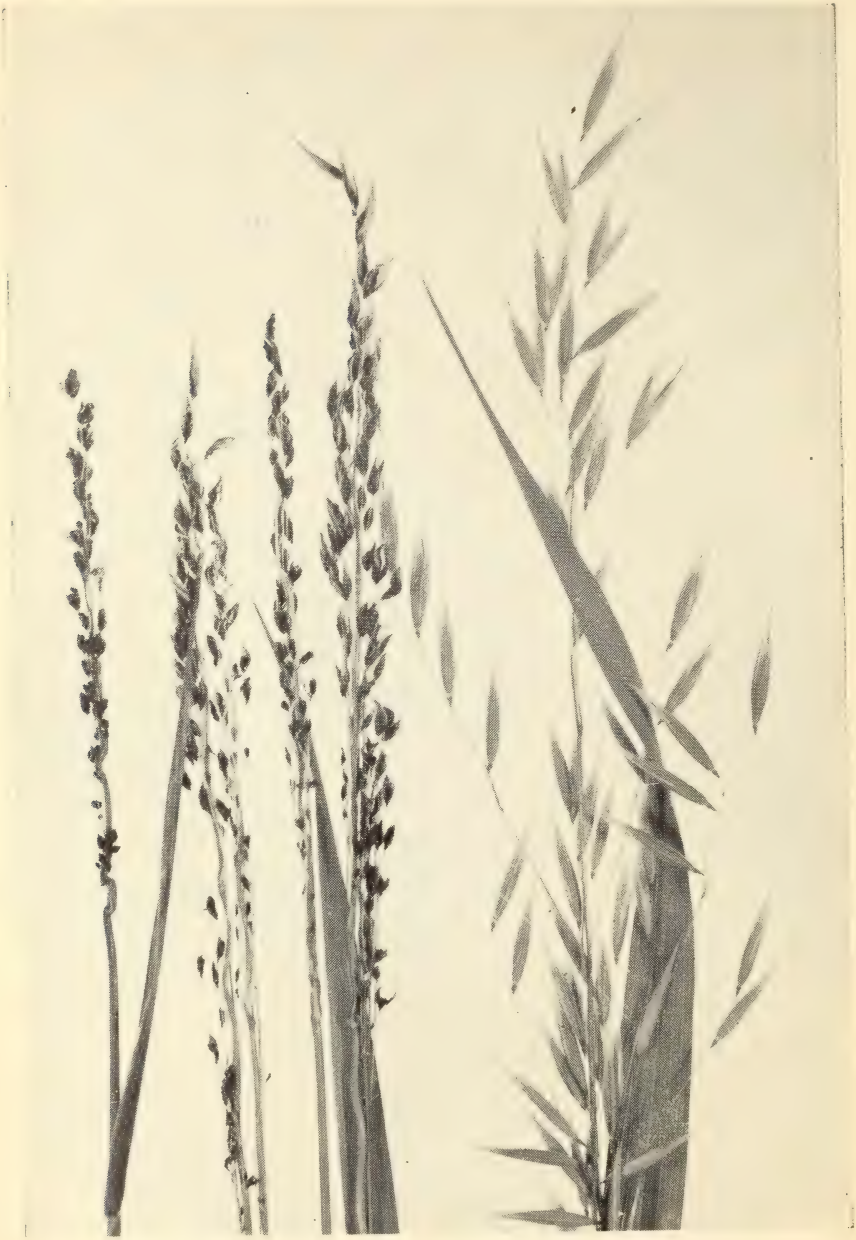

Figure 16.—Oat smut (left) and healthy plant (right).

looked at harvest because they are shorter than healthy plants and by harvest the heads have lost their black masses of spores

Life History*

The spores produced on the diseased heads are dispersed chiefly by the wind. Many of the spores lodge on the healthy heads, either on the chaff or between the chaff and the young kernel. Some of the spores germinate immediately, going into the hull or seed coat of the kernel, and remain inactive until the seed are sown the following spring. Other spores do not germinate immediately but remain on the seed grooves or between the hull kernel or fall to the ground where they may live for a long time and germinate after the seed are sown. In other cases after the oats are sown the fungus spores germinate or grow and infect the young oat shoot before it is very old. In order for smut to damage the yield of oats infection must start when the oat plant first germinates.

Control*

Smut, even though it is carried within the hull or the seed coat or in the soil, can be controlled without resorting to the old hot water method. Formaldehyde, smuttox and organic mercury compounds, if properly used will give practical oat smut control. Results of the use of some of these treatments are shown below.

Since Ceresan, New Improved Ceresan, and formaldehyde are widely used in Mississippi for the prevention of diseases of cotton and other crops, further details on how to use these chemicals may be found in Mississippi Agricultural Experiment Station Circulars Nos. 103 and 105. Additional information on plant diseases may also be secured by writing to the Agricultural Experiment Station Department of Plant Pathology.

Seed Treatment Experiments With Oats

Conducted by: United States Department of Agriculture, Bureau of Plant Industry.

Period: 1933.

Purpose: To test the effectiveness of disinfectants in the control of oat smut.

Procedure and Conditions: Lee oats grown from seed both naturally and artificially inoculated, treated with different fungicides were sown September 27, 1933, with a hand nursery drill in 65-foot rows replicated twice for each treatment and for each of the three methods of artificial inoculation. Series 1, seed inoculated with spores suspended in nutrient solution in vacuum; series 2, same as series 1, but using 2-percent dextrose solution; series 3, seed dustd with dry spores. (See table 145).

Effect of Storage on Yield of Oats in Illinois

Conducted by: Illinois Agricultural Experiment Station.

Conducted at: Urbana, Illinois.

Period: 1936.

Procedure and Conditions: The oat seed used in these tests was treated by applying New Improved Ceresan at the rate of ½, ¼, and ⅛ ounce a bushel. Because of lack of smut development in the Burt oats, conclusions on smut control can be drawn only from the tests with Iowar oats.

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*Reference: Illinois Natural History Survey, Circular 35, "Diseases of Small Grain Crops in Illinois," September 1939, Urbana, Illinois.

All plants were made in rod rows. A single row of seed from each treated lot and a check row were arranged at random in each block, and the blocks replicated sometimes 10 but usually 12 times. (See table 146).

Table 145.—Seed treatment test with oats, 1933.

Seed-treatment compound Name	Rate per bushel	Heads in series 1 Total	 Smutted	Heads in series 2 Total	 Smutted	Heads in series 3 Total	 Smutted
	Ounces	Number	Percent	Number	Percent	Number	Percent
Untreated	—	6,200	40.7	6,640	41.6	6,020	26.9
Ceresan	3	5,560	.4	6,280	2.4	6,670	.0
New Improved Ceresan	½	5,350	.4	6,300	1.6	6,500	.0
Sanoseed	3	5,940	15.5	6,000	34.3	6,180	2.2
Grainaid	3	5,940	3.2	6,200	4.0	6,130	.0
Smuttox	3	6,420	3.5	5,790	15.9	6,090	.0
Untreated	—	5,620	36.0	5,980	42.2	5,900	26.6
Anlus Dust	3	5,620	33.6	6,140	57.0	5,140	32.7
P. A. C. Dust	3	5,800	2.4	4,820	3.3	5,600	.2
S. K. 413-a	3	6,240	10.3	6,600	20.7	5,860	1.9
Hongosan	3	5,600	40.9	6,100	41.6	5,800	23.9
Formaldehyde 1:320	(1)	6,480	2.2	6,080	6.2	6,140	2.1
Uninoculated, untreated	—	6,540	6.5	6,400	6.5	7,220	6.5

(1) Seed immersed in a 1 to 320 solution 5 minutes, drained, and covered 2 hours.

Reference: United States Department of Agriculutre Technical Bulletin 568, "Seed Treatment Experiments with Oats Naturally and Artificially Inoculated with Smut," page 6, table 2, May 1937, Washington, D. C.

Table 146.—Yield and smut control when oat seed treated with New Improved Ceresan* was stored for various periods prior to planting—Illinois, 1936.

Time seed was stored after treatment and before sowing	Bushel rate of applying treatment	Burt oats Smutty	 Acre-yield	Iowar oats Smutty	 Acre-yield	Average increase from seed treatment
Days	Ounces	Percent	Bushels	Percent	Bushels	Bushels
Seed not treated	None	Trace	46.0	6.3	27.2	—
0	1/2	0	52.8	.0	39.6	9.6
	1/4	0	51.5	.5	38.7	8.5
	1/8	0	51.6	1.5	38.3	8.4
1	1/2	0	53.4	0	39.6	9.9
	1/4	0	52.5	.4	39.7	9.5
	1/8	0	51.6	1.2	40.8	9.6
23	1/2	0	52.5	0	37.3	8.3
	1/4	0	53.1	0	38.7	9.3
	1/8	0	53.6	.3	38.0	9.2
67	1/2	0	50.8	0	36.8	7.2
	1/4	0	51.2	0	37.4	7.7
	1/8	0	53.9	.04	38.9	9.8

*Active ingredient is ethyl mercury phosphate, 5 percent.

Reference: Illinois Agricultural Experiment Station Bulletin 476, "Effect of Storage on Yields of Farm Seed Treated for Disease Control," pages 260 and 261, table 1, April 1941, Urbana, Illinois.

Seed Treatments for the Control of Oat Smut

Conducted by: Illinois Agricultural Experiment Station.

Conducted at: Urbana, Illinois.

Period: 1928-1933.

Purpose: To determine the effect of seed treatments upon the control of oat smut.

Procedure and Conditions: The tests were made in rod rows, and each treatment was replicated 12 times. The check was replicated 24 times. The planting was done with a Columbia planter so adjusted as to sow 13 to 15 grams of seed per 16-foot row. Stand counts were made from separate plantings in which single seeds were spaced 2½ to 3 inches apart in the row so that the individual plants could be definitely distinguished. Usually 500 kernels were used for each treatment for this purpose.

Table 147.—Seed treatments for the control of oat smut—Illinois, 1928-33.

Seed treatment	Stand	Smut-infected heads	Acre-yield	Increase in acre-yield	
Average of 10 tests, 1928-1933					
	Percent	Percent	Bushels	Bushels	Percent
None	74.5	6.67	58.4	—	—
Formaldehyde, sprinkle	74.4	.01	62.4	4.0	6.8
Formaldehyde dust	74.0	.31	63.1	4.7	8.0
Ethyl mercury chloride*	81.4	.06	67.2	8.8	15.1
Average of 6 tests, 1932-1933					
None	76.8	11.65	42.8	—	—
Formaldehyde dust	78.9	.22	49.9	7.1	16.6
Ethyl mercury chloride*	82.0	.16	54.2	11.4	26.6
Ethyl mercury phosphate**	82.9	.15	54.7	11.9	27.8

*Ceresan. **New Improved Ceresan.

Reference: Illinois Agricultural Experiment Station Bulletin 420, "Seed Treatments for the Control of Certain Diseases of Wheat, Oats and Barley," pages 521 and 538, table 8, December 1935, Urbana, Illinois.